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## STUDIES ON PATTERNS OF FLUID INTAKE, WATER BALANCE AND FLUORIDE RETENTION.

By NEIL D. CROSBY AND PHYLLIS A. SHEPHERD,<sup>1</sup>  
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### PART I: PATTERNS OF FLUID INTAKE IN RELATION TO THE INGESTION OF PLAIN WATER.

THE mounting and sustained interest in fluoride therapy as a public health measure for the combating of dental caries makes it important to have adequate quantitative studies on various aspects of fluid balance and on the various avenues by which the fluoride ion is eliminated from the body.

The classical studies of Dean, Jay, Arnold and Elvove in 1941 and 1942, when over 7000 school children were subjected to dental examination, brought attention to a new biological role of fluorine. These workers showed beyond reasonable doubt that for children between the ages of twelve and fourteen years there was an inverse relationship between the incidence of dental caries in permanent teeth and the fluoride content of the public water supply, their data being collected in cities where

the water supplies contained between 0 and 3 parts per million of fluoride. This beneficial effect of the fluoride ion has aroused considerable interest, and the dental effect observed by Dean *et alii* has been confirmed by other workers for both deciduous and permanent teeth (Weaver, 1944; Bull, 1948).

It is not surprising that soon after the publication of the results of Dean and others, it was proposed to add fluoride to the water in communities lacking this element, and so attempt to reduced the incidence of carious teeth. In 1945 the first artificial fluoridation scheme was commenced at Newburgh, New York, and during the last ten years a large number of similar schemes have been started. In the majority of schemes the water is fluoridated at about one part of fluoride per million parts of water, for at this level Dean and associates claim that no fluorosis occurs, but that there is considerable dental benefit.

Many of the public health schemes in operation or under contemplation are concerned with the fluoridation of public water supplies. Because of this it is important to know the intakes of water by the various age groups of the populace. The daily water intake is dependent upon a large number of factors, of which age and the environmental climatic conditions are of primary importance. In addition there are other important factors, such as diet and the general metabolic activity of the individual, and also to an extent social customs, although this last factor is probably more important in determining the pattern of the fluid intake rather than the total fluid intake.

<sup>1</sup> Work done with the aid of a grant from the National Health and Medical Research Council.

Data regarding fluid requirements are for the most part of general rather than specific application, although there is considerable information for adults as regards basic rations and variations to compensate for climatic conditions and metabolic states (Adolph, 1947). The figures for children are based on various assessments, such as one millilitre per Calorie in the diet (McClure, 1943), requirements for infants under heat stress (Cooke *et alii*, 1950) or other more quantitative data (Levin and Cox, 1950); but detailed information either on the pattern of fluid intakes or on the likely distribution of intakes in selected groups of the population is seriously lacking. In any case, data for a given geographic and climatic region can be satisfactory only when gathered under appropriate conditions.

When the level of fluoridation was varied in the water supply of Charlotte, Carolina, to compensate for seasonal fluctuations in water intake, great difficulty was experienced in finding a reliable index on which to base the degree of fluoridation. Stadt (1954) records that the variation in fluoridation was based on the sales of soft drinks during various months of the year.

The fluoridation programmes for dental prophylaxis are of most importance to the young children of the community; but the adults will also be absorbing fluoride from the same water supply. Furthermore, not only does fluorine appear to be able to confer dental benefits, but also it can cause various toxic effects, of which the least harmful—although still objectionable cosmetically—is dental fluorosis producing mottled enamel. It would appear that mottled enamel may be encountered under the following circumstances: (a) in high dietary intakes apart from fluoride in water (Sognnaes and Armstrong, 1941); (b) in high water levels of fluoride (Hodge and Smith, 1954); (c) with expanded intake of water which has a low fluoride content (Dean, 1951). Hence, it is important to have not only data which quantitate the differences in water balance between various age groups, but also data for those age groups in relation to climatic conditions.

It is realized that in regions such as Perth, Western Australia, considerable volumes of sweat are lost during the hot summer season of the year. It is essential to know two things in relation to this sweat loss: (i) the magnitude of the losses; (ii) the potentialities of the sweat route as a source of excretion of fluoride.

The studies presented here are concerned with four main features: (i) the relationship of age to patterns of fluid intake and fluid balance; (b) the relationship of fluid intake and excretion to the climatic conditions of the metropolitan area of Perth; (c) the magnitude of the skin losses of fluid; (d) the magnitude of fluoride elimination in sweat.

#### Methods.

Data were obtained for the daily fluid intakes and urinary outputs of individuals resident in the Perth metropolitan area. The figures were collected from the same individuals during a period of warm summer weather, and during a period of cold winter weather.

The twenty-four hour excretion of fluoride in both sweat and urine was measured under two conditions: (a) without, and (b) with an oral dose of three milligrammes of fluoride added to the daily intake of food and fluid.

#### Fluid Intake and Output.

The data collected in the first section of the project were largely determined by the number of cooperative subjects who could be obtained. It was desirable that the subjects be not only cooperative, but also actively interested in the work, because an incentive for accuracy was required to produce worthwhile results. The subjects had to be available for instruction and supervision, so that the validity of the figures could be checked as far as possible. For these reasons, the number of subjects whose data were finally used was not large.

The subjects who were used fall into three groups. These groups were each drawn from a separate source, as a

result of which they fall naturally into three distinct age groups, as follows:

Group I was formed by ten male and six female children who attended a pre-school kindergarten. Their ages ranged from three to five years. The children were supervised by P.A.S. during the kindergarten hours, while the remainder of the readings were taken by their parents. The parents of these children were extremely interested in the project, and were highly cooperative in obtaining sets of accurate figures. This group provided 195 observations of fluid intake and 187 observations of fluid output during a two-week period of the winter.

The observations under summer conditions unfortunately had to be made prior to the kindergarten summer recess, and although the weather at this time was warm, it did not really represent the climate which prevails at the hottest periods of the year in this region. This set of readings was collected over a two-week period, and provided 201 observations of daily fluid intake and 172 observations of fluid output.

Group II was formed by 18 schoolgirls, whose ages ranged from twelve to fifteen years. The girls were resident at a girls' college in the metropolitan area of Perth, and made an ideal group, as their diets were nearly the same and their activities comparable. This group took the readings quite voluntarily, and were, without exception, interested in obtaining accurate figures. These girls were all able to use calibrated vessels, but were given partial supervision by P.A.S. during both summer and winter periods. The group gave 125 observations for a period of winter weather, and 247 observations during three weeks of hot summer weather.

Group III was a small group of only three adults, who were from the Physiology Department of the University of Western Australia. These adults, one male and two females, gave 93 observations during two months of winter and 80 observations during two months of summer.

As all the subjects, particularly those in Groups II and III, were leading normal active lives, occasions arose when it was extremely difficult and even quite impossible to obtain full sets of readings during a twenty-four hour period. For this reason, not all individuals in the groups were always measuring on the same days. In the calculation of the means for the fluid intake, outputs, etc., and in the construction of the histograms, this fact was disregarded.

The observations which were used for work relating maximum daily temperature to fluid intake were observations from the same individuals taken on the same days. In Group II the number of individuals was reduced to 11, and the number of observations for winter and summer to 121.

Prior to the commencement of the experimental period, the subjects were issued with two measuring vessels and a standard record sheet. The first measuring vessel was a drinking glass which had been calibrated in increments of millilitres. This vessel was used for the measurement of all fluid ingested. The second vessel was a household measure which was calibrated in increments of 0.5 ounce, and this was used for the collection and measurement of all urine passed. Readings for a twenty-four hour period were commenced after the first amount of urine was passed in the morning, and terminated with the volume of the first amount of urine passed on the following morning. The volumes were recorded on the standard sheet under suitable headings—e.g., water, milk, tea, coffee, soup etc., and urine. The twenty-four hour total intakes could then be found, and the total daily intakes of the various components of the fluid diet were recorded. The sheet also provided for the recording of any abnormal fluid losses, and in the event of such an observation, the whole day's set of readings was omitted from the data which were finally used. The subjects were asked to indicate whether any readings were inaccurate or whether a set of readings was incomplete; if so, these readings were similarly discarded.

TABLE I.  
Kindergarten Group.

| Twenty-four Hour Fluid Intake<br>and Urine Output.<br>(Millilitres.) | Winter. |                         |                         | Summer. |                         |                         |
|--|---------|-------------------------|-------------------------|---------|-------------------------|-------------------------|
|  | Mean.   | Maximum<br>Observation. | Minimum<br>Observation. | Mean.   | Maximum<br>Observation. | Minimum<br>Observation. |
| Fluid intake .. .. .   | 651     | 1485                    | 180                     | 744     | 1540                    | 250                     |
| Urine output .. .. .   | 587     | 1008                    | 212                     | 485     | 1050                    | 200                     |
| Water intake .. .. .   | 119     | 500                     | 0                       | 166     | 1040                    | 0                       |
| Water and fluids mainly water .. .. .                                | 200     | 875                     | 0                       | 292     | 1410                    | 0                       |
| Tea .. .. .  | 35      | 365                     | 0                       | 53      | 470                     | 0                       |
| Milk .. .. .   | 369     | 840                     | 0                       | 362     | 1130                    | 0                       |

## Results.

The pattern and quantity of the daily fluid intake and of the twenty-four hour urine volume were recorded for three groups of subjects. In two groups—namely, the group of 16 kindergarten children and the group of 18 schoolgirls—the observations for the groups were totalled and a mean value was obtained. These mean values, together with the minimum and maximum observations in the group, are given in Tables I and II. Figures are given in these tables for the following: (a) the total fluid intake over twenty-four hours; (b) the twenty-four hour urine output; (c) the daily intake of tap water; (d) the daily intake of water and fluids which are mainly water; these include tea, black coffee, cordials, soft drinks, soups and alcoholic beverages; (e) the daily intake of tea; (f) the daily intake of milk.

The mean daily fluid intake is slightly greater than the sum of the intake of water and water-containing fluids (see (d) above) plus the intake of milk in the kindergarten group, this discrepancy being a small intake of pure fruit juices, which is not represented separately in the results.

Both groups show an increase in mean daily intake with the higher environmental temperature of summer, and a decrease in urinary output of fluid is apparent with the rise in temperature. The first table shows that the younger children receive a fairly constant milk intake throughout the year, the increase in intake in summer being made up by an increase in water-containing fluids.

The group of older girls, whose results are given in Table II, showed higher fluid intakes and urine outputs than the kindergarten children in winter. They showed an increase in total daily intake and a decrease in total urine output when the temperature was increased in summer. This group had a decreased milk intake and a decreased tea intake in the summer, but there was an increase in the other components of the fluid intake to nearly twice the winter level.

Figures I to VIII show the distribution of the observations of total fluid intakes for twenty-four hours and the twenty-four hour urine volume for the kindergarten children and the schoolgirls.

Figures I and II show the distribution of all observations of the twenty-four hour fluid intake for the kindergarten children in winter and summer respectively. Figures III and IV show the distribution of the urine output observa-

tions for the same group under two climatic conditions. In all four histograms the observations are distributed over a range, the bulk of the observations being distributed around the mean value in each case.

Figures V and VI represent the distribution of the observations for the schoolgirls' total daily fluid intake in winter and summer respectively, while Figures VII and VIII show the distribution of their urine outputs in winter and summer. With this group, Figures V and VII are taken from half the number of observations used for Figures VI and VIII. The distribution in these four histograms is very similar to that displayed in Figures I to IV.

To obtain a more precise relationship between the maximum environmental temperature and the fluid intake, the sample size of the schoolgirl group was reduced to give a set of observations made by the same individuals on the same days.

An analysis of variance on the fluid intake figures from the same individuals on the same days showed that there is a significant individual effect and a significant day effect. The significant day effect can be expressed in terms of the variability in daily maximum temperatures. The quadratic regression of intake on temperatures is highly significant ( $P < 0.01$ ).

Figure IX shows the curve obtained when the daily intake of the schoolgirls is related to the maximum temperature. Both terms of the equation are significant, giving a curve the second order derivative of which is positive. Thus with the group of girls the fluid intake increases with temperature, and the rate of increase increases with rise in maximum temperature.

A third group of individuals was studied for fluid intakes and outputs. This group contained only three adults. As the group was small, the results for each individual and for both seasonal conditions are presented in Table III. The total intakes, twenty-four hour urinary volumes, and daily intakes of tap water and of fluids which are mainly water, tea and milk, are given in this table as the minimum observation, the mean of the observations and the maximum observation. The total intake in all subjects is increased under summer conditions, while the urine volume is decreased. The increased total intake in summer is a reflection of an increased intake of water and fluids which are predominantly water. Comparison between Table III and Tables I and II indicates a marked increase in tea ingestion with age, and a decrease in milk intake with age.

TABLE II.  
Schoolgirls.

| Twenty-four Hour Fluid Intake<br>and Urine Output.<br>(Millilitres.) | Winter. |                   |                   | Summer. |                   |                   |
|--|---------|-------------------|-------------------|---------|-------------------|-------------------|
|  | Mean.   | Maximum<br>Value. | Minimum<br>Value. | Mean.   | Maximum<br>Value. | Minimum<br>Value. |
| Fluid intake .. .. .   | 994     | 2210              | 370               | 1895    | 3325              | 390               |
| Urine output .. .. .   | 1081    | 1810              | 274               | 732     | 1676              | 200               |
| Water intake .. .. .   | 203     | 700               | 0                 | 770     | 2910              | 0                 |
| Water and fluids mainly water .. .. .                                | 568     | 1290              | 20                | 1069    | 3175              | 190               |
| Tea .. .. .  | 227     | 720               | 0                 | 178     | 850               | 0                 |
| Milk .. .. .   | 429     | 1050              | 0                 | 335     | 1320              | 0                 |



### Discussion.

The results, which are summarized in Tables I to III and in Figures I to IX, show some interesting facts with regard to the fluid habits in terms of fluid intake of some of the inhabitants of Perth, Western Australia, spread over three distinct age groups. These results furnish some quantitative data for total fluid intakes and for the

season were nearly equal. For this group the mean urine volume is slightly greater than the fluid intake, because, under the conditions in which measurements were taken by this group, it was impracticable to measure semi-liquid foods such as custards, gravies etc. The mean winter values for fluid intake and urine output for the three adults (Table III) were approximately equal.

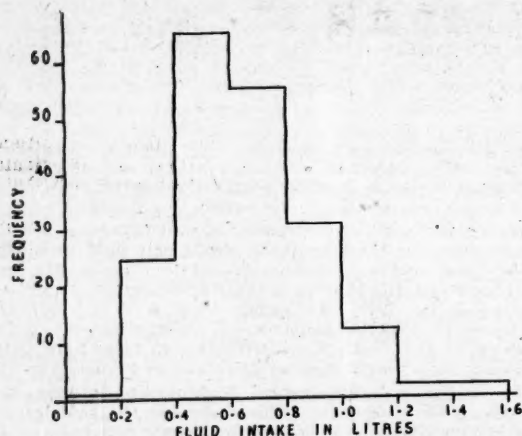


FIGURE I.

Kindergarten group; daily fluid intake in winter.

bulk, including the most important, of the components of the daily fluid intake. They also give an indication of the importance of climate as a determining factor in the fluid intake.

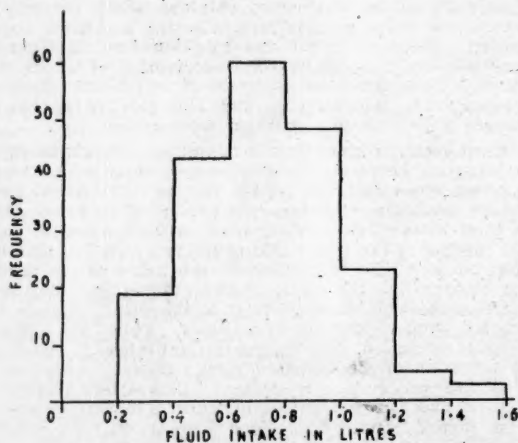


FIGURE II.

Kindergarten group; daily fluid intake in summer.

For the group of young children (Table I), the mean daily fluid intake in winter is approximately equal to the twenty-four hour urinary output. This indicates that, under the winter conditions, the sources of fluid which were not measured—namely, the water in foodstuffs and water from metabolic processes—must approximately equal the extrarenal water loss. As the readings were taken in winter, when active sweating is negligible, evaporation of water at the lungs and insensible water loss at the skin surface constitute the extrarenal loss.

In the group of schoolgirls (Table II), the mean values for daily fluid intake and urinary volume in the winter

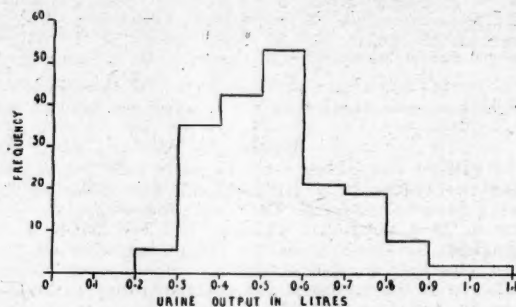


FIGURE III.

Kindergarten group; twenty-four hour urine output in winter.

The readings for the three groups taken during the summer months show a large difference between the fluid intake and the urine volumes. Since the method of measurement appears to give results in which the neglected sources of water approximate the extrarenal water loss, this discrepancy must represent the water loss due to active skin secretion or sweating. The magnitude of the difference between the total fluid intake and the daily urine volume increases with increasing age, and so with increase in surface area. Variations in the lung and insensible water losses with rises in temperature cannot be quantitated, and it seems likely that increases in skin water loss with temperature rise are caused by low rates

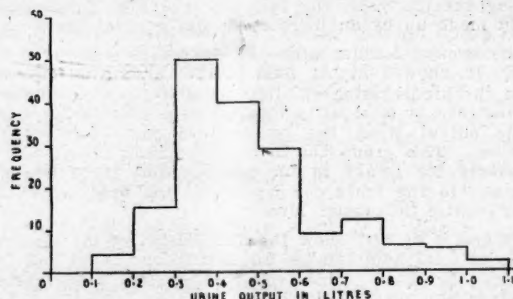


FIGURE IV.

Kindergarten group; twenty-four hour urine output in summer.

of active sweating rather than by increased insensible water loss. Hence the difference between fluid intake and urine output has been taken as an approximation of the sweat loss in the summer. The mean sweat loss in Perth's climate, as measured in this way, will reach three and four litres in the adult, even when the level of physical activity remains short of strenuous work, or with little strenuous activity.

Figures I to VIII indicate the wide variation in the daily fluid intake and urine output within the two samples of children. It is apparent that under both climatic conditions and in both age groups, the daily fluid intake and the daily urine output are distributed in a manner which suggests that, if sufficient data were available, a reasonably symmetrical distribution would be obtained. In the



two groups of children the daily fluid intakes cover a wide range in both winter and summer, and although the bulk of the children fall within a much narrower range at the centre of the distribution, the children at the extremities of the range cannot be ignored.

This distribution of the fluid intakes poses some interesting problems in relation to the fluoridation of water. If fluoridation was effected so that the bulk of the child population, as represented by these children, received a daily dose, it would seem that a number of children would receive a very much smaller dose, while

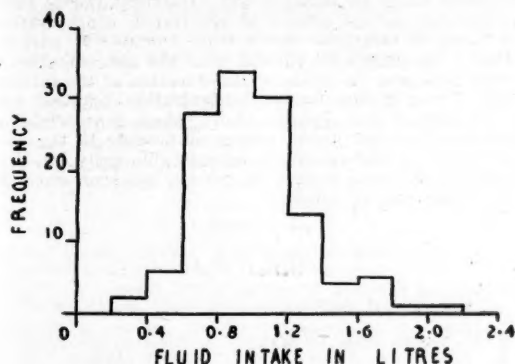


FIGURE V.

Schoolgirl group; daily fluid intake in winter.

others would receive almost twice the dose. The problem immediately arises whether, in giving benefit to the bulk of the population, a small percentage of the population would receive an overdose sufficient to produce mottling, and whether some would not receive a dose sufficient to afford any material benefit. Secondly, it is interesting to refer to some figures of Hodge and Smith (1954) on the incidence of mottling in various communities. These authors show the incidence of various grades of mottling in four communities, each of which has a different fluoride level in the public water supply. The first area considered is Elgin, where the water supply has 0.5 part per million of fluoride. Here 65% of the children show no mottling, 30% of the children are classified as showing a "questionable" degree of mottling, while the remaining 5% show between "questionable" and "mild" grades of mottling. In Joliet, where the water supply contains a higher level of fluoride—namely, 1.3 parts per million—only 35% of the children show no mottling, in 45% it is graded as

"questionable" and in 20% as "very mild", and a few children in a thousand showed "mild" to "moderate" mottling. When Colorado Springs with a fluoride concentration of 2.6 parts per million is considered, the proportion of normal children—that is, normal with respect to mottling—falls to less than 10%, 20% show a "questionable" degree of mottling, 40% show "very mild" mottling, 20% show "mild" mottling, while 10% show "moderate" mottling and about 1% show "severe" mottling. In the fourth community studied, Amarillo, the water supply contains 3.9 parts per million. Here about 55% of the children show mottling ranging up to "mild", over 30% show "moderate" mottling, and 15% show "severe" mottling.

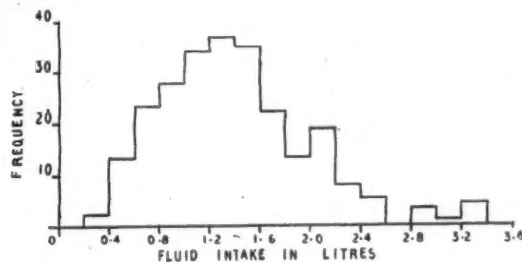


FIGURE VI.

Schoolgirl group; daily fluid intake in summer.

When these results are graphed, the two communities with the high fluoride content in the water supply show an interesting distribution of the various grades of mottling. In the case of Colorado Springs there is a high peak of incidence towards the centre of the distribution—that is, at "mild" mottling—while the remainder of the population is distributed on either side of this peak. In the graph for Amarillo the curve is skewed to the right; but again there is a peak of incidence, this time at "moderate" mottling. The authors discuss various factors which could account for this distribution of degrees of mottling within the various communities. Comparison of the curves obtained at Colorado Springs and the histograms which were obtained for fluid intakes in the present investigation reveals a marked similarity. This similarity could explain the incidence of the various degrees of mottling. Should the histograms presented here as Figures I, II, V and VI be representative of the community as a whole, then if water supplies were fluoridated at currently accepted levels, the population would be receiving a range of doses because of the range in daily intakes. Such a range of doses distributed throughout the community could give a range of incidence of the various grades of mottling.

TABLE III.

| Subject. | Twenty-four Hour Fluid Intake and Urine Output. (Millilitres.) | Winter.              |       |                      | Summer.              |       |                      |
|----------|--|----------------------|-------|----------------------|----------------------|-------|----------------------|
|          |  | Minimum Observation. | Mean. | Maximum Observation. | Minimum Observation. | Mean. | Maximum Observation. |
| J.M.B.   | Fluid intake .. .. .   | 1110                 | 1278  | 2085                 | 1600                 | 1968  | 3550                 |
|          | Urine output .. .. .   | 1015                 | 1244  | 2414                 | 660                  | 1015  | 1155                 |
|          | Water intake .. .. .   | 0                    | 56    | 310                  | 0                    | 290   | 1565                 |
|          | Water and fluids mainly water                                  | 1110                 | 1180  | 1845                 | 1155                 | 1806  | 3440                 |
|          | Tea .. .. .  | 160                  | 617   | 870                  | 310                  | 825   | 1295                 |
|          | Milk .. .. .   | 0                    | 116   | 335                  | 0                    | 121   | 700                  |
| N.D.C.   | Fluid intake .. .. .   | 865                  | 1436  | 2260                 | 960                  | 1816  | 4510                 |
|          | Urine output .. .. .   | 910                  | 1483  | 2160                 | 840                  | 1175  | 1920                 |
|          | Water intake .. .. .   | 0                    | 43    | 600                  | 0                    | 164   | 1210                 |
|          | Water and fluids mainly water                                  | 715                  | 1152  | 1930                 | 760                  | 1638  | 4510                 |
|          | Tea .. .. .  | 170                  | 612   | 1240                 | 190                  | 999   | 1690                 |
|          | Milk .. .. .   | 0                    | 284   | 725                  | 0                    | 164   | 850                  |
| P.A.S.   | Fluid intake .. .. .   | 655                  | 1034  | 1550                 | 845                  | 1815  | 2947                 |
|          | Urine output .. .. .   | 508                  | 941   | 1600                 | 523                  | 816   | 1201                 |
|          | Water intake .. .. .   | 0                    | 37    | 550                  | 0                    | 321   | 1190                 |
|          | Water and fluids mainly water                                  | 485                  | 981   | 1690                 | 655                  | 1667  | 2831                 |
|          | Tea .. .. .  | 0                    | 432   | 755                  | 160                  | 712   | 1210                 |
|          | Milk .. .. .   | 0                    | 48    | 330                  | 0                    | 60    | 200                  |

In the group of kindergarten children, the daily intake of tap water and of fluids which are mainly water is extremely low in winter, and even in summer the mean value is less than 300 millilitres per day. These figures for the mean values are lower than those generally accepted for the adult, and the data also show that some children drink no water or fluids containing water on some days. Also several of the children on repeated occasions gave a daily reading less than one hundred millilitres. The range for intake of these fluids is very great, a few readings of 0.8 litre being obtained in this same group of children.

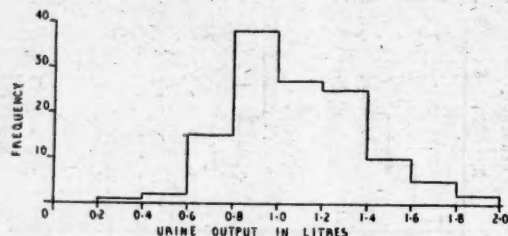


FIGURE VII.

Schoolgirl group; twenty-four hour urine output in winter

With increase in age, the percentage of daily fluid intake formed by water and fluids which are mainly water increases from the kindergarten group to the adult group. The rise in percentage is from about 30 to about 90 in winter, and from about 40 to about 90 in summer. As the adult population, which unfortunately is represented by only three sets of readings, has a much higher total intake, the daily intake by the adult of water and fluids

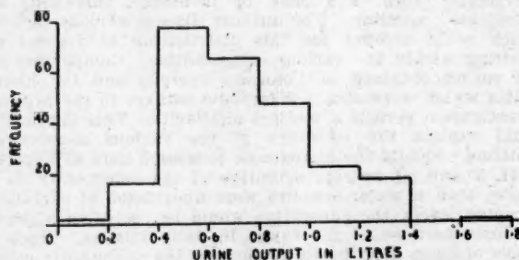


FIGURE VIII.

Schoolgirl group; twenty-four hour urine output in summer.

which are mainly water greatly exceeds that of the child. The mean value for the adult is five to six times as great as the value for the child.

If water was fluoridated to provide a dose of one milligramme of water-borne fluoride per day to the bulk of the child population, then the adult population would be receiving a five milligramme daily dose, which is above the desirable level for daily dosage. If the children were to be supplied with 0.5 to 0.7 milligramme of fluoride (McClure, 1949), the adult would still be receiving from 2.5 to 3.5 milligrammes per day. It must be stated that these figures are based on small samples of individuals, and hence their representation of the entire population is limited; however, they do give some indication of the variations which exist between the level of fluid intake of the child and of the adult. The data also indicate the differences in the type of fluid ingested to make up the daily fluid intake of different age groups.

The fluoride content of tea can be very high. The mean intake of tea is given in Tables I, II and III for the three

age groups studied. The youngest age group shows very small intakes of tea per day, the maximum readings being provided by one child, who drank quantities of tea far in excess of the remainder of the group in winter. If this child's figures are deleted, the mean value in winter drops from 35 to 25 millilitres per day. The mean intake of tea is considerably increased with the increase in age to fourteen years. It is interesting to note that at this age the mean tea intake in summer is slightly lower than in winter. Apparently these children show a preference for cool drinks in the hot weather. The three adults studied all show a considerable tea intake per day, the summer level being 0.7 to 1.0 litre per day. Harrison (1950) found that for the various brands of tea tested, concentrations in a range of infusions varied from 0.46 to 0.91 part per million. Harrison also showed that the concentration of fluoride depended on strength and duration of the infusion of tea. These figures for tea concentration, together with the volumes of tea ingested daily, show that while tea would not be a significant source of fluoride to the child population, it could provide a considerable daily intake of fluoride to the adult population, of the order of one milligramme per day in summer.

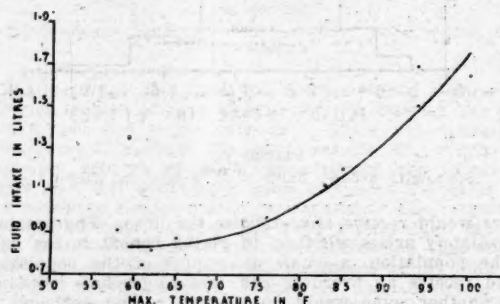


FIGURE IX.

Schoolgirls; relationship between total daily fluid intake and maximum daily temperature.

An analysis of variance on a set of data for fluid intake taken by the same individuals on the same days showed a significant effect due to individuals, and a significant effect due to days, on both the kindergarten children and the schoolgirls. It is assumed that the effect due to individuals on fluid intakes would relate to differences in size, dietary habits and activity, and probably a difference in social customs could contribute.

The correlation between the temperature and the fluid intake (Figure IX) shows that the day effect is primarily a temperature effect. The group of girls was resident in an institution, and so all received similar diets, and their daily routine was such that their physical activity was similar. The graph for the schoolgirls, however, does not indicate that a maximum sweat loss will be reached, but that the daily sweat loss will increase with increase in environmental temperature indefinitely, the relationship being terminated only when environmental temperatures which are incompatible with life are reached.

A similar set of data was collected for the kindergarten group. Although these readings clearly indicate the magnitude of the increased fluid intake in summer, they do not cover as wide a range of temperature at the higher ranges as did those for the girls' school, nor were the subjects under as uniform a regime. Hence it is not possible to draw more definite conclusions from a comparison of the two sets of data.

The relationship between fluid intake and temperature is not new. However, the problem of quantitating this relationship to provide a measure of changes in fluid intake for the community is considerable. Stadt, in his résumé on the dental benefits of fluoride ingestion in "Fluoridation as a Public Health Measure", outlines the need for data

of this kind, to determine the levels of fluoride in water supplies which would be required in various seasons to give dental benefit. The results presented here indicate that in the adolescent at least there is a very great increase in fluid intake at high environmental temperatures.

#### Summary.

1. Quantitative data are presented concerning the intakes of fluid and the patterns of fluid intake of three distinct age groups for Perth, Western Australia.
2. The effect of climate upon fluid intake is shown, together with the relevant correlation curve.
3. The distribution of the intakes in summer and winter for the two pre-adult age groups is shown in graphical form.
4. The data yield information relevant to problems inherent in fluoridating water supplies in regions subject to severe summer climatic conditions, and, in conjunction with the graphs, indicate the expectable distribution of (a) efficient dosage and (b) mild grades of dental fluorosis.

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#### A CLINICAL TRIAL OF TWO ANTI-DIABETIC DRUGS FOR ORAL USE.

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A PROPORTION of diabetic patients will respond to treatment with certain sulphonamide compounds and closely related derivatives by a fall in blood sugar level and a decrease in glycosuria. This therapeutic application was reported in 1955 by Achelis and Hardebeck, by Franke and

Fuchs, and by Bendfeld and Otto. French workers, notably Janbon (1942) and Loubatières (1944), had recorded that sulphonamido-thiadazole compounds reduced the blood sugar levels of both animals and man, but they did not apply this knowledge to the treatment of diabetes. Since 1955 there has been intense interest in this subject, and many reports have been published from centres throughout the world. A careful preliminary report by Ewen Downie *et alii* (1956) from the Alfred Hospital, Melbourne, has already appeared in this journal.

It is agreed that these drugs do not act after pancreatectomy or after destruction of islet cells by alloxan. They are ineffective in the treatment of young, thin patients with acute diabetes, and valueless in combating ketosis. It appears that the presence of some circulating insulin is necessary for their hypoglycemic activity to become evident. The elderly, obese patient with relatively mild diabetes is most likely to respond in a satisfactory manner by a fall in blood sugar level, disappearance of urinary glucose and abolition of symptoms. The purpose of this trial was to assess the value of these preparations in the treatment of patients in a diabetic clinic, subject to the usual controls and investigations available in an out-patient clinic.

The following drugs were used in the trial: N-sulphanilyl-N-n-butylcarbamide ("Carbutamide", BZ55, "Bucrol"); N-p-tolylsulphonyl-N-n-butylcarbamide ("Tolbutamide", "Rastinon"). The drugs were supplied in tablet form (0.5 gramme), and the standard dosage was three grammes on the first day, two grammes on the second day, and one gramme daily thereafter in divided doses.

#### Selection of Patients.

This report concerns 28 patients, of whom seven were men and 21 were women. The trial was initially restricted to patients aged over fifty years, whose diabetes had been controlled for some months by diet and moderate doses of insulin. Subsequently it was decided to include three patients whose condition had previously been controlled on diet alone, and three patients recently diagnosed, whose diabetes could not after adequate trial be controlled on diet alone.

#### Methods.

The first 23 patients were subjected to a "double-blind" placebo control using BZ55 and placebo tablets, each for two weeks. The remaining five patients were treated without placebo control.

Patients were instructed to suspend insulin, to conform to their previous diet, to continue recording the results of their home tests for urinary sugar excretion, and to report to the clinic weekly. At each visit, in addition to the usual examination of the urine, weighing and clinical examination, a blood sugar estimation was performed at 10 a.m. and at 3 p.m. This weekly routine was continued for at least six weeks, and then at less frequent intervals. After one week without insulin, treatment was commenced with either BZ55 or placebo tablets. Neither the patient nor his attending physician knew whether this treatment consisted of tablets of BZ55 for two weeks followed by placebo tablets for two weeks, or vice versa. It was considered that one response of the patient to the suspension of insulin might be a more accurate observance of his dietary restrictions, and the use of a placebo could prevent attributing any improvement from this cause to the drug being used. Patients were further instructed to report immediately any untoward symptoms or signs, such as fever, rash, sore throat or digestive upset.

After this initial trial period of five weeks, the further management of the patient was determined individually, either on diet alone if possible, or with the addition of insulin, or BZ55, or "Tolbutamide" ("Rastinon"). All patients were ambulant, and all continued to take a diet which had been considered suitable for their previous management. The Calorie content of these diets ranged from 1200 to 2200. In 22 cases, the diabetes had been controlled for long periods on doses of insulin ranging



from 14 to 96 units per day, most being of the order of 20 to 30 units.

#### Results of Initial Trial Period.

Determination of the success or failure of the initial trial period of treatment was based on (i) the mean blood sugar estimations before and after treatment, (ii) the patient's symptoms, (iii) his weight, (iv) the results of his home tests for urinary sugar excretion, (v) the result of weekly examination at the clinic, and (vi) evidence of toxicity. These will be considered separately. The salient features are summarized in Table I.

In the group of 23 patients subjected to placebo control, there were 19 whose condition had previously been controlled with insulin. One week after the suspension of insulin therapy the mean blood sugar level had risen to 200 milligrammes per 100 millilitres or more in 15 cases. In a further four patients previously controlled with insulin, the blood sugar content did not reach hyperglycemic levels in this time, and their subsequent course showed they could be controlled adequately with diet alone. These results have not been classified as successful. In the whole series, treatment with either BZ55 or "Tolbutamide" resulted in a significant fall in mean blood sugar levels in 23 of 28 cases. In these cases the fall ranged from 30 to 150 milligrammes per 100 millilitres, the average fall being approximately 60 milligrammes per 100 millilitres. In some cases the degree of fall, although marked, was not sufficient to reduce the mean blood sugar level below 200 milligrammes per 100 millilitres (Figure 1).

#### Toxic Effects.

A probable toxic effect of administration of the drug was recorded in three cases, and in each the drug was suspended immediately. Two patients showed toxic effects with BZ55, one presenting fever and albuminuria, one presenting sore throat and a rash. One patient receiving "Tolbutamide" presented a severe urticarial reaction. Estimations of liver function, full blood counts and microscopic examinations of the urine in these cases showed no abnormality, and the effects were transient.

#### Urinary Sugar Estimations.

The urinary sugar estimations were performed by the patients four times daily, using either Benedict's solution,

or "Clinitest". Glucose in the urine was not estimated quantitatively at the clinic. Broadly, the results of these estimations were in accord with the blood sugar estimations, although in four cases a high renal threshold was disclosed. It should be noted that the exhibition of "Tolbutamide" may result in the excretion in the urine of a heat-coagulable substance which can be differentiated from albumin by a modified Esbach's (picric acid) test. The incidence of toxic effects in this trial was 8%, which corresponds with that of other series.

#### Weight and Ketosis.

There was no significant change in the weight of any patient during the course of the trial.

Ketosis did not result in any case, in spite of the suspension of the previous insulin dosage for the period of five weeks.

#### Subsequent Management.

After the trial period of five weeks, the subsequent management of all patients was determined individually. If diet alone was unsuccessful, insulin or BZ55 or "Tolbutamide" was given. The period of observation since the trial has been from three to eight months in 24 of the 28 cases. This management has been set out in Table II.

One death occurred two months after the conclusion of the trial.

The three patients previously controlled with diet alone have continued to be controlled with diet alone. In addition, six patients previously considered to require insulin in doses ranging from 24 to 36 units per day have been controlled with diet alone. This result should not be attributed to the drugs used, as in no case did hyperglycemia occur in the first week after insulin had been suspended. Diet and insulin have been used in the subsequent management of eight patients, but two of these had had a successful trial with BZ55, and these patients warrant a further trial with "Tolbutamide" for prolonged maintenance. "Tolbutamide" has been used successfully for several months in seven cases; in a further two the degree of control is not considered satisfactory, and the dosage has been increased from one gramme to 1.5 grammes daily.

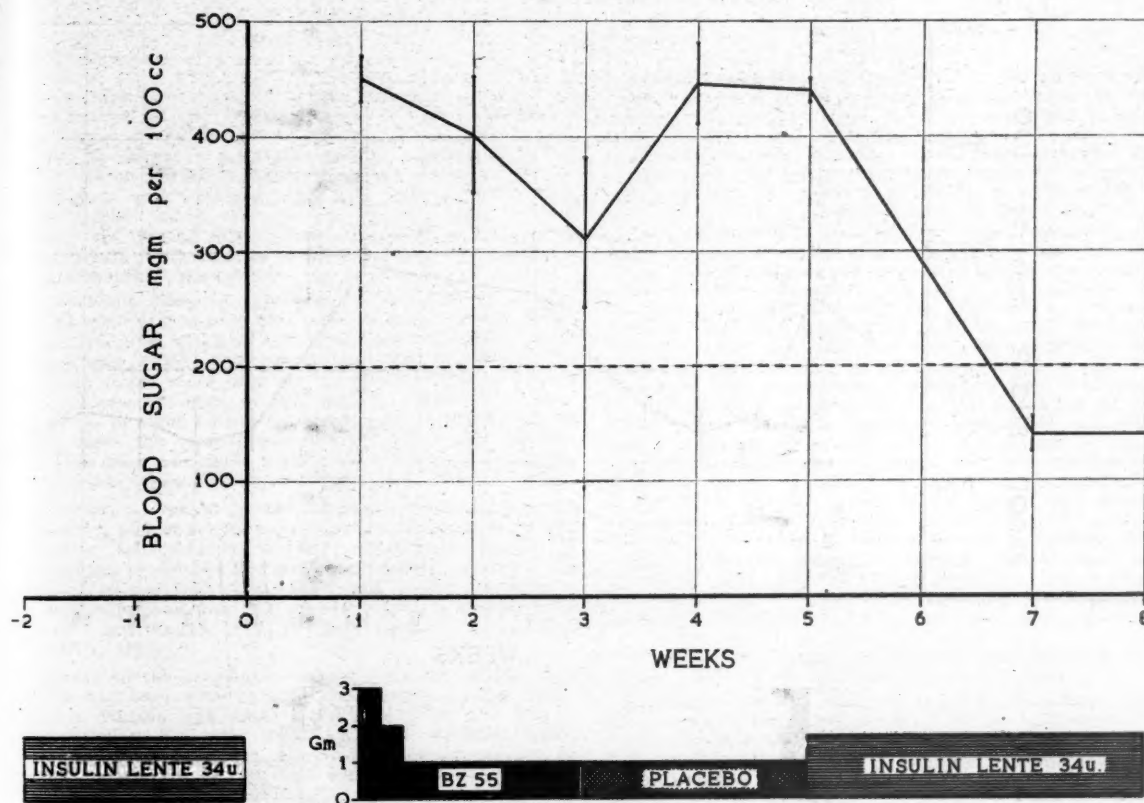
TABLE I.

Summary of Data of Trial. Cases 1 to 23, Placebo Control Trial with BZ55; Cases 24 to 28, "Tolbutamide" without Placebo Control.

| Case Number. | Sex. | Age. (Years.) | Insulin Dosage. (Units.) | Mean Blood Sugar Levels. (Milligrammes per 100 Millilitres.) |              |       | Comment.                     |
|--------------|------|---------------|--------------------------|--|--------------|-------|------------------------------|
|              |      |               |                          | Before Trial.  | After Trial. | Fall. |                              |
| 1            | F.   | 58            | Lente, 34.               | 450  | 300          | 150   | Failure—inadequate response. |
| 2            | M.   | 66            | Lente, 34.               | 160  | 120          | 40    | Doubtful—diet only required. |
| 3            | F.   | 54            | Lente, 30.               | 200  | 140          | 60    | Successful.                  |
| 4            | M.   | 72            | Lente, 36.               | 210  | 160          | 40    | Successful.                  |
| 5            | F.   | 64            | Lente, 24.               | 230  | 180          | 50    | Successful.                  |
| 6            | F.   | 58            | P.Z.I., 30.              | 320  | 240          | 80    | Failure—inadequate response. |
| 7            | M.   | 72            | Lente, 28.               | 220  | 150          | 70    | Successful.                  |
| 8            | F.   | 68            | Sol.I., 96.              | 220  | 140          | 80    | Failure—toxic effect.        |
| 9            | F.   | 74            | Refused.                 | 270  | 180          | 90    | Successful.                  |
| 10           | F.   | 62            | Lente, 16.               | 250  | 150          | 100   | Successful.                  |
| 11           | M.   | 72            | Lente, 14.               | 240  | 240          | —     | Failure.                     |
| 12           | F.   | 70            | Lente, 16.               | 200  | 150          | 50    | Failure—toxic effect.        |
| 13           | F.   | 50            | Nil.                     | 170  | 130          | 40    | Successful.                  |
| 14           | F.   | 65            | Lente, 20.               | 150  | 120          | 30    | Doubtful—diet only required. |
| 15           | F.   | 64            | Lente, 24.               | 120  | 120          | —     | Failure—diet only required.  |
| 16           | M.   | 76            | Lente, 18.               | 260  | 160          | 100   | Successful.                  |
| 17           | F.   | 57            | Nil.                     | 150  | 120          | 30    | Doubtful.                    |
| 18           | F.   | 62            | Nil.                     | 130  | 80           | 50    | Doubtful.                    |
| 19           | M.   | 72            | Lente, 24.               | 150  | 150          | —     | Failure—diet only required.  |
| 20           | F.   | 63            | Lente, 16.               | 320  | 180          | 140   | Successful.                  |
| 21           | F.   | 60            | Lente, 24.               | 230  | 200          | 30    | Successful.                  |
| 22           | F.   | 50            | Lente, 24.               | 290  | 170          | 120   | Successful.                  |
| 23           | F.   | 64            | Nil.                     | 220  | 130          | 90    | Successful.                  |
| 24           | F.   | 79            | Lente, 72.               | 200  | 150          | 50    | Successful.                  |
| 25           | F.   | 84            | Nil.                     | 230  | 150          | 80    | Failure—toxic effect.        |
| 26           | F.   | 53            | Sol.I., 40.              | 250  | 200          | 50    | Doubtful.                    |
| 27           | F.   | 67            | Lente, 30.               | 230  | 120          | 110   | Successful.                  |
| 28           | M.   | 80            | Lente, 30.               | 70   | 150          | —     | Failure—diet only required.  |

\* Protamine zinc insulin.

\* Soluble insulin.

**CASE 1. FEMALE AGE 58. WEIGHT 150 lb. DIET 1200 C.****FIGURE I.**

Fall in blood sugar level not sufficient for control of hyperglycemia, rise with substitution of placebo, subsequent control with insulin.

The patient who died was a man, aged seventy-two years, with a perforating ulcer of the foot. Before the trial he had been controlled on 14 units of lente insulin daily. His mean blood sugar level after the suspension of insulin rose to 240 milligrammes per 100 millilitres. There was no response to BZ55, and he was subsequently recontrolled with diet and insulin. Two months later he developed diabetic gangrene in the left leg, congestive cardiac failure and azotemia.

**Discussion.**

Of diabetic patients requiring insulin, the greatest problems arise in relation to the young, unstable diabetics and to those suffering from ketosis and infection; but the largest individual group consists of the middle-aged patients with diabetes of moderate severity. Patients in this group were chosen for trial, and although the period of follow-up has been limited to a few months, the drug "Tolbutamide" has been used successfully for the maintenance management of seven patients, and the drug BZ55 for one patient. The number of patients selected has been limited by the conditions of the trial. It was necessary that the patients be willing, and intelligent enough to cooperate, and able to attend the clinic weekly for at least six weeks. It was considered inadvisable to include any patient who had previously suffered from ketosis, in view of the danger of this complication following the suspension of insulin therapy. Apart from one patient with a perforating ulcer of the foot, none of the patients was suffering from any serious complications. In this selected

group, a short trial period with BZ55 has resulted in a significant fall in blood sugar level in 23 of 28 patients. The preliminary period without insulin has also disclosed a number of patients whose insulin dosage was probably not necessary. The hypoglycemic response to BZ55 in

**TABLE II.**

| Subsequent Management.   | Number of Patients. | Comment.  |
|--------------------------|---------------------|---|
| Diet alone . . . . .     | 9                   | Includes 6 patients previously having insulin.                                      |
| Diet and insulin . . . . | 8                   | Includes 2 patients whose trial was successful.                                     |
| Diet and BZ55 . . . . .  | 1                   | Control satisfactory.   |
| Diet and "Tolbutamide" . | 9                   | Control satisfactory, 7 patients; control fair, 1 patient; control poor, 1 patient. |

relation to the mean blood sugar levels after a period of diet control alone has enabled us to predict with reasonable accuracy those patients likely to be adequately controlled on a maintenance dosage (Figure II). The failures included those patients who showed toxic reactions, those who appeared completely refractory to the drugs used, and those

## CASE 10 FEMALE. AGE 62. WEIGHT 152 lb DIET 1800 C.

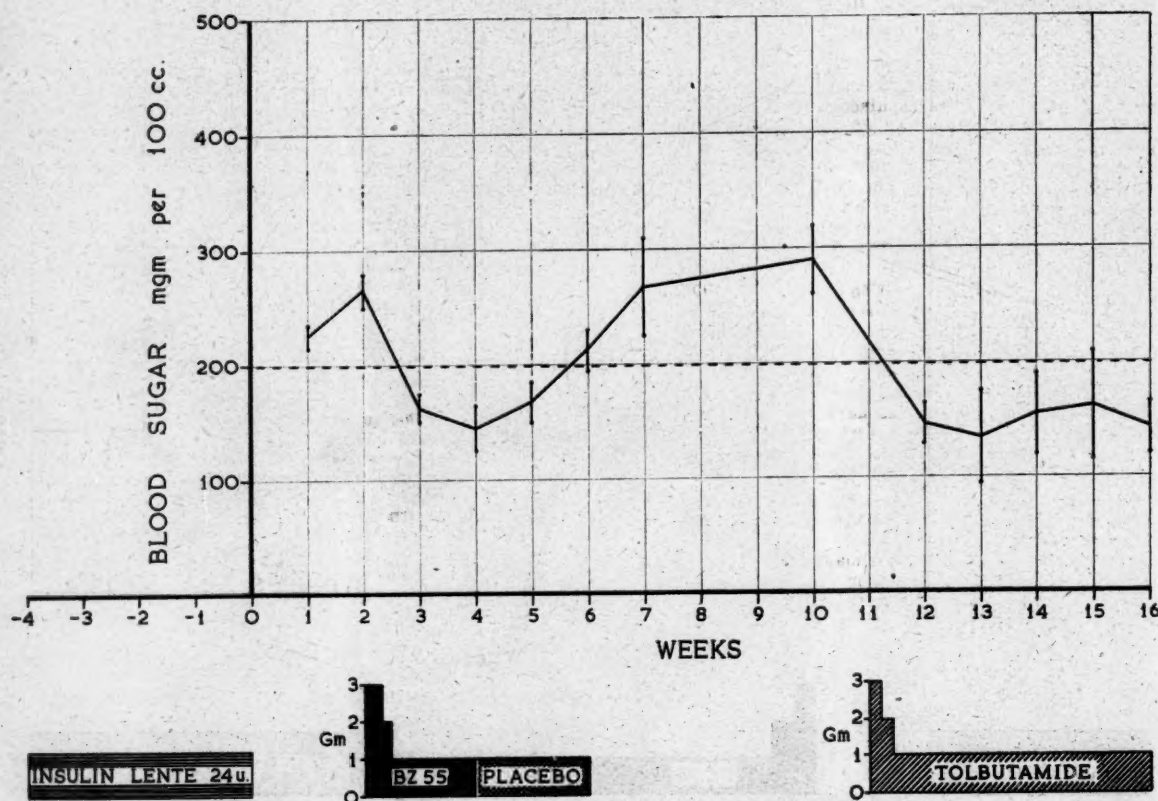


FIGURE II.

Fall in blood sugar levels with BZ55 therapy, rise with substitution of placebo, subsequent control with "Tolbutamide".

whose response was significant, but insufficient to control their hyperglycaemia. In retrospect, there were no features in the history or previous management of these patients by which such failure might have been anticipated. It can be argued that the only advantage of this group of drugs is one of convenience—they can be taken orally. For this advantage the patient must run the risk of toxicity, ketosis and failure, and must realize that in the event of superadded infection or complication insulin may again be required. It will be some considerable time before the mode of action of these drugs is determined, and longer before it is shown that they are as valuable as insulin in the prevention of the vascular and renal lesions to which diabetic patients are particularly prone.

Provided these dangers and limitations are recognized, there is a proportion of elderly patients with mild diabetes who may be controlled by these orally administered anti-diabetic drugs, particularly when defective vision or other physical disability makes insulin administration impracticable. For the majority of diabetics uncontrolled by diet alone, the proven long-term efficiency and safety of insulin are preferred to the use of these new, and potentially toxic, substances given orally.

#### Summary.

In a group of middle-aged to elderly diabetic patients, who previously could not be controlled by diet alone, eight out of 25 have been satisfactorily controlled for several

months by the use of the drugs BZ55 or "Tolbutamide" in a dosage of one gramme per day.

A trial period of two weeks has been sufficient to estimate with reasonable accuracy whether a patient can be controlled by these drugs.

Toxic effects were found in three patients. There were no cases of ketosis when insulin was suspended.

The procedure adopted for the initial trial and subsequent management has not extended beyond the routine of the out-patient management of a diabetic clinic.

The enthusiasm of the patients for this alternative to daily injections makes it important that the immediate and remote dangers and the limitations of these drugs should be widely known before they become generally available for therapeutic use.

A significant fall in blood sugar, averaging 60 milligrammes per 100 millilitres, occurred in 23 of 28 patients treated with either BZ55 or "Tolbutamide". The present lack of knowledge concerning the mode of action or long-term efficiency of these drugs warrants neither their condemnation nor their approval.

#### Acknowledgements.

The drug BZ55 was supplied for this trial by Eli Lilly and Company, Limited, and by Boots, Proprietary, Limited. The drug "Tolbutamide" was supplied by Farbwerke Hoechst A.G., through Fawns and McAllan, Proprietary, Limited.



## PRESERVATION OF ANAL SPHINCTERS IN THE TREATMENT OF CARCINOMA OF THE RECTUM.

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THE lack of agreement on the selection of cases for preservation of the anal sphincters in the treatment of carcinoma of the rectum is reflected in the figures published by surgeons possessing special experience in this field. Bacon (1956) reports that in 66% of his cases the sphincters were retained; but both Morgan (1955) and Muir (1956) found this possible in only 27% of their cases. Yet despite this variation in practice, there is no fundamental difference in views concerning the pathology of carcinoma of the rectum.

Carcinoma does not spread in the walls of the rectum to the same degree as it does in the stomach (Clogg, 1904). Monsarret and Williams (1913-1914) and Goligher, Dukes and Bussey (1951) have shown that it is exceptional for it to be found more than one or two centimetres beyond the macroscopic edge of the tumour. Admittedly extensions up to eight centimetres have been recorded; but in such cases the tumour has been of high-grade activity, and has been associated with gross extramural lymphatic obstruction (Quer, Dahlin and Mayo, 1953; Grinnell, 1954).

Extramural spread by the lymphatic channels is more extensive, and is mostly in an upward direction along the superior haemorrhoidal vessels. Downward spread is infrequent, even when the proximal lymphatic channels are blocked by malignant infiltration, and hardly ever does it extend more than four centimetres below the tumour edge (Glover and Waugh, 1946; Grinnell, 1953; de Peyster and Gilchrist, 1955).

Spread to the lymphatic vessels along the lateral ligaments has been demonstrated convincingly (Miles, 1926; Gordon Watson and Dukes, 1930; Gilchrist and David, 1938; Collier, Kay and McIntyre, 1940; Freidin, 1954). Surgeons are well aware that removal of this avenue is sharply restricted by the rigid walls of the pelvis.

From these pathological considerations it is clear that adequate resection of a carcinoma of the rectum entails division of the rectum at least two centimetres and the extrarectal tissues at least five centimetres below the edge of the tumour, section of the lateral ligaments as close to the lateral walls of the pelvis as possible, and removal of the superior haemorrhoidal lymphatic channel. In a number of cases it is possible to do this and preserve the anal sphincters. In this review the writer analyses his own experience with restorative excision of the rectum and discusses the indications for such a procedure.

### Present Series.

#### *Incidence of Restorative Excision.*

In a personal series of 302 patients with carcinoma of the rectum subjected to operation, 42 have had a sphincter-saving operation. Since January, 1956, 25 of 63 patients have had restorative excisions; this indicates a decided trend by the writer in favour of preserving the anal sphincter.

#### *Clinical Features of Cases Selected for Restorative Excision.*

There were 23 male and 19 female patients. The oldest patient was aged eighty-seven years and three others were aged over eighty years; nine patients were aged between seventy and eighty years. The youngest patient was aged forty-five years. In 24 of these patients the tumour was palpable with the finger and lay 10 centimetres or less from the anal margin. In 18 the tumour was visible on sigmoidoscopic examination, and was situated between 11 and 18 centimetres from the anus.

### *Histological Activity of the Tumour.*

In each of the 42 cases histological examination showed the tumour to be an adenocarcinoma, either of average or of low-grade activity. More anaplastic tumours were treated by combined excision.

#### *Treatment of Tumours Seven Centimetres from Anal Margin.*

Restorative excision was performed on five patients with tumours situated seven centimetres or less from the anal margin. In each of these cases an abdominal excision with transanal anastomosis was performed; the lower part of the sigmoid colon and the rectum were mobilized and excised, and the upper part of the sigmoid colon was pulled through the intact anal sphincters. The stump of the anal canal was everted so that the lower end of the sigmoid colon could be sutured to its upper end outside the anus, after which the anastomosis was replaced into the pelvis. In each of these five cases some degree of separation occurred at the anastomosis. In two it was complete; one of these patients died despite the fact that a transverse colostomy had been constructed at the time of the operation; the other recovered after a second operation on the sixth post-operative day, at which an abscess in the left iliac fossa was drained and a colostomy was established. In one of the three with incomplete separation of the suture line a colostomy had been established and there was no more serious complication. In a second patient a recto-vaginal fistula was the sequel, but this subsequently gave little trouble. In the third case of partial separation of the suture line the patient was a female, aged eighty-six years, and death occurred on the seventh post-operative day after a fall out of bed. Although no autopsy was performed on this patient, it seemed probable that her restlessness was produced by the toxæmia of pelvic infection. All three survivors have adequate, if imperfect, sphincteric function.

#### *Treatment of Tumours Situated Between Seven and Ten Centimetres from the Anal Margin.*

Restorative excision was performed on 19 patients with tumours extending to within seven to ten centimetres of the anal margin. In 15 of these cases an abdominal resection (anterior resection) with end-to-end anastomosis was performed; the lower part of the sigmoid colon and the rectum were mobilized and excised, and the upper part of the sigmoid colon was anastomosed to the stump of the rectum which remained. In one of these cases the uterus, vagina and uterine adnexæ were removed with the rectum (Figure 1). There were no deaths, and convalescence in each case was uneventful. Sphincteric function appeared to be normal. In three cases a caecostomy was established at the conclusion of the operation, and this was allowed to close spontaneously.

In four cases a Babcock "pull-through" operation was performed; the lower part of the sigmoid colon and the rectum were mobilized and excised and the upper part of the sigmoid colon was pulled through the anal canal after the sphincters had been slit posteriorly. A length of about six centimetres of bowel was left projecting, but was trimmed off seven to ten days after operation. There were no deaths in this group and the convalescence was again smooth. Sphincteric function was imperfect in each case.

#### *Treatment of Tumours Situated Above Ten Centimetres from the Anal Margin.*

In 18 cases the tumour was situated more than 10 centimetres from the anus; in 16 the tumour was less than 15 centimetres from the anus, whilst in the remaining two the tumours extended to within 17 and 18 centimetres of the anus respectively. These tumours were regarded as situated in the upper third of the rectum or at the recto-sigmoid junction, but involving the upper third of the rectum. Tumours above 18 centimetres from the anal margin have been included with carcinomata of the sigmoid colon.

In each of these cases an abdominal resection with end-to-end anastomosis was performed. A caecostomy was

constructed in two at the conclusion of the anastomosis. One patient required a laparotomy on the twenty-fifth post-operative day because of small-bowed obstruction caused by the adhesions, and one patient had a severe wound infection. All these patients have had normal sphincteric function.

#### Discussion.

As 25 of the 42 patients in this series were submitted to surgery in the last fifteen months, the follow-up period is too short to permit firm conclusions. Nevertheless, certain observations can be made concerning factors which influence a decision in favour of sphincter preservation in the treatment of carcinoma of the rectum.

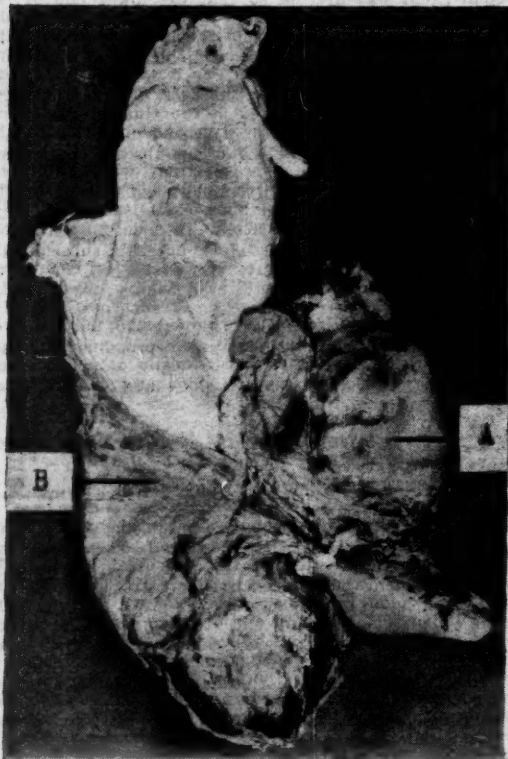


FIGURE 1.

A, uterus and adnexae; B, rectum.

#### Distance from the Anal Margin of the Lower Border of the Tumour.

Nearly all authorities have declared themselves emphatically in favour of combined abdomino-perineal excision of the rectum with permanent colostomy if the tumour is situated within seven centimetres of the anal margin (or within six centimetres of the dentate line) (Waugh, Miller and Kurzweg, 1954; Black, 1955; Gray, 1955; and Mayo and Fly, 1955). Bacon (1956), who has consistently advocated sphincter preservation, states: "The only surgical procedure for low-lying carcinoma, less than seven centimetres from the anal margin, is extended abdomino-perineal excision with permanent abdominal colostomy." The writer has performed restorative excisions in five instances in which the tumour was situated seven centimetres or less from the anal margin; in each of these there was some special circumstance which influenced the choice of the procedure. There is similar unanimity of opinion in favour of sphincter preservation in carcinoma of the rectum 15 centimetres or more from the anal margin.

Most argument concerns those tumours situated between eight and 15 centimetres from the anus, and variations in practice are concerned with this group. Black (1955) holds that nearly all tumours above the eight-centimetre level can be removed safely with restoration of continuity; but Gray (1955) places the level at 12 centimetres, although he is prepared to relax this rule if the tumour is of the less malignant polypoid type, or if the patient has hepatic metastases or suffers from serious concomitant disease. Mayo and Fly (1956) produced five-year survival figures to support restorative excisions for low-lying tumours; but Naunton Morgan (1955) and Muir (1956) are critical of such statistics, because low tumours for which a combined excision is necessary have a poorer prognosis.

On passing a finger into the anal canal, tumours reaching to within seven centimetres of the anus can be felt easily, and it is the writer's practice to remove all such tumours by a combined abdomino-perineal excision. If pressure is exerted on the perineum, it is possible to feel with the tip of the finger tumours reaching to within eight to ten centimetres of the anus. If the tumour in these cases is of low-grade or average histological activity, it may prove suitable for restorative excision, but a final decision is made at operation. Tumours above the 10-centimetre level are out of reach of the finger, but visible with the sigmoidoscope; these can nearly always be removed and the sphincter preserved.

#### Histological Activity of the Tumour.

The investigations of Goligher, Dukes and Bussey (1951) and of Quer, Dahlin and Mayo (1953) indicate that tumours which possess a highly active histological structure may have spread outside the ordinarily accepted margins of safety. Therefore, if biopsy examination shows the tumour to be of high-grade activity, and if it is situated within 10 centimetres of the anus, a combined excision should be performed (Morgan, 1955; Muir, 1956), although it is doubtful whether this will influence the prognosis (Grinnell, 1954).

#### Findings at Operation.

If the tumour is below the seven-centimetre level from the anus, the procedure of election is a combined abdomino-perineal excision of the rectum with a permanent colostomy, and the operation can proceed for such an excision; but if the tumour is situated higher in the rectum it is important that the surgeon defer his final decision as to the feasibility of preserving the sphincters until after laparotomy has been performed and the rectum mobilized (Waugh and Kirklin, 1948; Pack and Ariel, 1955). One of the disadvantages of the synchronous procedure lies in the fact that a decision in favour of combined excision may be influenced by the perineal surgeon eager to start.

Butler (1952) and Naunton Morgan (1955) will not perform an anterior resection unless the tumour is situated above the peritoneal reflection, regardless of the distance from the anal verge, and Muir (1956) insists that the tumour be at least five centimetres above this reflection. On the other hand, Waugh and his associates (Waugh, Miller and Kurzweg, 1954) and Mayo and Fly (1956) do not regard the peritoneal reflection as an important landmark. In this series of patients treated by restorative resection, there were 15 instances in which the tumour was situated below the peritoneal reflection. Although the survival periods of patients with low-lying tumours are not so satisfactory as those of patients with higher tumours, it is unlikely that restorative excisions will affect the results adversely, provided that the surgeon is careful in his selection.

If the patient is obese and the pelvis is small and cramped by a large prostate, it may be better to conduct the dissection from a perineal approach, so excluding restoration of continuity. Furthermore, at laparotomy the sigmoid colon may be found so short that sufficient length cannot be obtained, despite retention of long lengths of the marginal artery and mobilization of the splenic flexure and transverse colon.



### Method of Restoration of Continuity.

Mobilization of the rectum down to the level of the levator ani muscle is accomplished in a more or less uniform way; but the methods used to restore continuity have varied.

End-to-end anastomosis through the abdominal incision (anterior resection) is the technique used by almost all surgeons for tumours above 15 centimetres from the anal margin, and many advocate it for tumours at a lower level in the rectum, provided that resection can be safely carried out from an abdominal approach (Morgan, 1955; Muir, 1956). The mortality and morbidity of the operation are low and the functional results excellent. In the writer's series, 33 patients were subjected to anterior resection and anastomosis without mortality. There was one case of severe wound sepsis, and one patient required laparotomy on the twenty-fifth post-operative day to relieve a bowel obstruction due to adhesions.

It is a tedious operation when performed deep in the pelvis, and if the pelvis is small and the bladder and prostate are large, it may be impossible to restore continuity by this means. Apart from this technical difficulty, Bacon (1956) rejects the operation because of the danger of implantation of tumour cells in the suture line (Goligher, Dukes and Bussey, 1951; Vink, 1954; McGrew, Lawes and Cole, 1954); but Naunton Morgan has reduced the incidence of this complication from 21.4% to 2.09% by the use of mercuric perchloride rectal washouts immediately before the anastomosis is performed (Morgan, 1955).

Some surgeons favour an abdomino-sacral procedure. The rectum and sigmoid colon are mobilized and resected through an abdominal incision; but anastomosis deep in the pelvis is avoided by exposing the rectal stump through a posterior incision, which entails removal of the coccyx and the lower part of the sacrum. The procedure was devised by Tuttle in 1896 (Tuttle, 1905), and has been advocated by Aylett (1949), and by Best, Potter and Rasmussen (1955). No such operation has been performed by the writer because of the high morbidity rate of the procedure in the hands of some skilful surgeons who have tried it.

Maunsell (1892) and Weir (1901) mobilized the rectum and the lower part of the sigmoid colon through an abdominal incision, and restored continuity by invaginating the bowel through the intact anal sphincters. Babcock divided the sphincters and pulled the sigmoid colon through into the perineum; this was done on four occasions in the present series with a smooth convalescence, but with indifferent faecal control after operation. Bacon attempted to rectify this and left the anal sphincters intact. After the sigmoid colon has been withdrawn through the sphincters, it is amputated so that a length of about six centimetres of colon is left protruding; a week later this is trimmed away. The difficulty with this procedure has been the incidence of sloughing of the sigmoid colon (Butler, 1952), although it occurred in less than 1% of Bacon's cases (Bacon, 1956). In five cases of the writer's series in which an anastomosis was performed outside the anus at the time of the initial operation, sloughing or separation of the suture line was responsible for at least one, and probably for both, of the deaths which occurred in the series. Therefore, although Welch and Rheinlander (1952) have advocated this method, it has been abandoned by the writer as unsafe. If restoration of continuity is required for a very low-level tumour and it is not possible to perform an anastomosis deep in the pelvis, the writer proposes to give Bacon's method a trial in the future.

In most instances in which the tumour is suitable for anterior resection, it is possible to perform the anastomosis by direct suture. The functional result following such restoration is excellent, whilst that following the "pull-through" procedures has been imperfect (Goligher and Hughes, 1950).

### Conclusions.

The surgical treatment of carcinoma of the rectum is based on the results of painstaking pathological research. Upward and lateral spread is more important than down-

ward spread, and this has enabled the surgeon to preserve the anal sphincters in certain cases.

A tumour situated within seven centimetres of the anal margin (or six centimetres from the dentate line) is unsuited for restorative resection because the sphincters are damaged by an adequate excision. These tumours are easily felt on digital examination (Figure II).

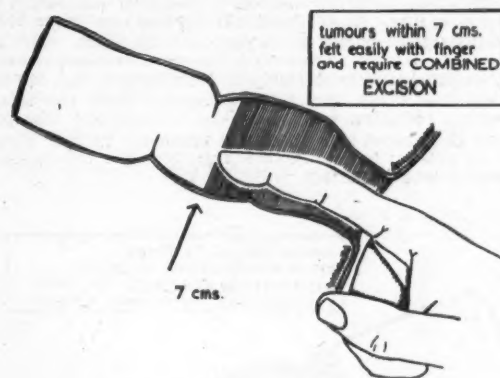


FIGURE II.

A tumour situated above the 10-centimetre level measured from the anal margin can nearly always be removed satisfactorily with preservation of the anal sphincters by direct end-to-end anastomosis. These tumours cannot be felt on digital examination, but are visible with the sigmoidoscope (Figure III).

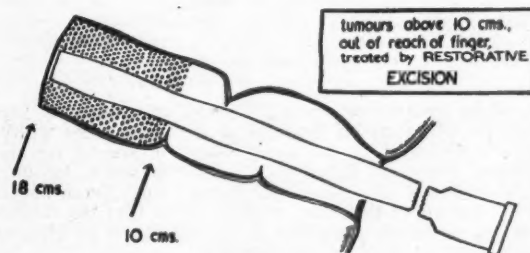


FIGURE III.

Tumours situated between seven and ten centimetres from the anus present a difficult surgical problem, and the variation in practice observed in published figures concerns this group (Figure IV). These can be felt with the tip of the finger, provided that pressure is applied to the perineum during digital examination. These tumours may be suitable for restorative excision if histological examination reveals low-grade or average activity. But the final decision is made at operation. If it is possible to resect the tumour adequately from above, and if the sigmoid colon will reach the rectal stump without tension, a restorative excision will be feasible. Direct abdominal end-to-end anastomosis is the procedure preferred by the writer, because in most instances in which it has been possible to perform an abdominal resection it has been possible to perform an abdominal anastomosis. If the tumour lies within seven centimetres of the anus, the price of restoration of continuity is not only an increased recurrence of the tumour, but an increased mortality and morbidity.

### Summary.

1. The extent of the excision for carcinoma of the rectum is based on pathological research, the results of which have been widely accepted.



2. Spread upwards along the superior hemorrhoidal lymph channels and into the lateral ligaments is progressive, but in a downward spread it is limited, and therefore permits preservation of the sphincter in certain cases.

3. A personal series of 42 restorative resections is reviewed. The tumour lay within seven centimetres of the anus in five instances; in each an abdominal resection with a transanal anastomosis was performed. Two of these patients died, both probably as a result of separation of the suture line. In 18 cases the tumour lay more than 10 centimetres from the anus, and in each case an abdominal (anterior) resection with end-to-end anastomosis was performed without loss. In 19 instances the tumour lay between seven and ten centimetres from the anus; abdominal resection with end-to-end anastomosis was performed in 19 cases and a Babcock procedure in five. There were no deaths; but sphincter function after the Babcock procedure was imperfect.

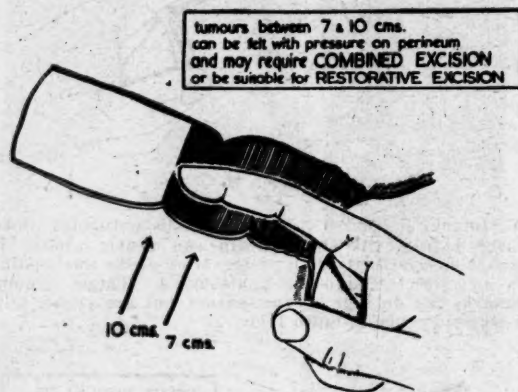


FIGURE IV.

4. Most authorities decline to make an attempt to preserve the sphincters if the edge of the tumour lies within seven centimetres of the anus, except in special circumstances. There is difference of opinion about tumours lying between the seven-centimetre and 10-centimetre levels; but above this most workers agree that the sphincters can be saved, especially if the tumour is as high as 12 centimetres or 15 centimetres from the anus.

5. If the tumour possesses a high degree of histological activity a combined excision should be performed if it lies within 10 centimetres of the anus.

6. A final decision regarding the preservation of the sphincters for tumours situated seven to ten centimetres from the anus should not be made until laparotomy has been performed and the rectum freed.

7. Abdominal resection with end-to-end anastomosis (anterior or segmental resection) has a low mortality rate and gives excellent functional results. It is a difficult procedure when the anastomosis has to be performed at the level of the levator ani muscle. Two alternative procedures were tried in this series, the Babcock sphincter-dividing "pull-through" operation, and anastomosis in the perineum after withdrawal of the sigmoid colon through intact sphincters. Sphincter function was weak in the former operation, but it was performed safely, whilst in the latter group two patients were lost in the post-operative period.

8. It is concluded that tumours easily felt with the finger should be removed by combined excision. Tumours which can be reached only by firm pressure on the perineum may prove suitable for restorative excision; but the surgeon should reserve final decision until laparotomy and mobilization of the rectum. Tumours out of reach of the finger can be treated by restorative excision.

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# MURRAY VALLEY ENCEPHALITIS: A SURVEY OF HUMAN AND ANIMAL SERA IN QUEENSLAND.

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AN outbreak of Murray Valley encephalitis in Victoria and New South Wales from January to March, 1951, was described in a series of papers by Anderson, French and their colleagues (1952). It was shown that the virus concerned was related to, but not identical with, Japanese B encephalitis, and McLean (1953) demonstrated that it could be transmitted by several species of mosquitoes in the laboratory. Attempts were made to isolate the virus from wild mosquitoes in the Murray Valley in December, 1951, and at Townsville in April, 1952, and November, 1954; but the evidence suggests that the virus had disappeared from both districts when the surveys were made (Reeves *et alii*, 1954; M. J. Mackerras *et alii*, 1952, 1955).

A complement-fixation test was developed by Donnelley and French (1953) and used by Anderson *et alii* (1952) to investigate the distribution of infection in human and animal populations. French (1952) also developed a neutralization test in suckling mice, which was found to be satisfactory for testing bird serum (Anderson, 1953).

In Queensland the aborigines on Mornington Island in the Gulf of Carpentaria suffered from an outbreak of fever, with involvement of the central nervous system, in February and March, 1951. Sera were collected, and sent to Dr. S. G. Anderson for investigation. He found complement-fixing antibodies in the human and equine sera (Tables I and II), and neutralizing antibodies in five

land, or whether the virus invaded the State in waves. If it came in waves, it was hoped to determine their periodicity and direction of movement. J. L. O'Connor had advised in 1951 that there would probably be serological cross-reactions between Murray Valley encephalitis and dengue, so the earlier examinations were concentrated on horse serum. Sweet and Sabin (1954), by means of the haemagglutination inhibition test, showed that the dengue viruses were antigenically related to the virus of Japanese B encephalitis, and Smithburn (1954) found that a Murray Valley encephalitis human convalescent serum contained weak neutralizing antibody against the dengue type I virus. An opportunity came to examine these cross-reactions when dengue appeared in North Queensland early in 1954.

TABLE II.

Complement-Fixation Tests on Patients from Mornington Island, 1951 and 1953.

| Year.             | Number of Subjects. | Negative Results. | Positive Results: Titre. |              |       |
|-------------------|---------------------|-------------------|--------------------------|--------------|-------|
|                   |                     |                   | 1:5 to 1:10              | 1:11 to 1:20 | >1:20 |
| 1951 <sup>1</sup> | 107                 | 60                | 18                       | 15           | 14    |
| 1953              | 11                  | 10                | 1                        | —            | —     |

<sup>1</sup> The 1951 tests were carried out by Dr. S. G. Anderson.

## Materials and Methods.

Horse serum was obtained on request from September, 1953, until December, 1955, through the courtesy of the Department of Agriculture and Stock. The specimens were from normal animals, except for four animals at Milman that were affected by "coastal staggers", and a single one at Mount Garnet suffering from "walkabout disease".

A number of sheep sera were also sent for examination because of an outbreak of encephalitis. A collection of native animal sera made in 1945 by Major (now Professor) Frank Fenner, and a number of bandicoot, rat, bovine and canine sera were sent by the Laboratory of Microbiology and Pathology, Brisbane.

Human serum was received from many parts of Queensland; but the greatest number of specimens was from the Institute's Field Station at Innisfail, where patients were under investigation for fevers of unknown origin. Paired specimens were usually available. The sources of all human and animal sera are shown in Figure 1.

Complement fixation tests were carried out as described by Donnelley and French (1953), by the use of an antigen prepared from the chorio-allantoic membranes of infected eggs, with an extract of normal membranes of the same age as control. It was found convenient to use complement preserved with the boric acid-sodium acetate mixture of Campbell and Turner (1953), and sheep blood taken into the glucose-citrate-"Merthiolate" solution of Stubbs (1953). Preserved complement was usable for two weeks, and the sheep blood for two months.

Neutralization tests were performed for us by our colleagues in the Institute. In the first series, the tests were performed by a modification of the method of French (1952). Three dilutions of virus, prepared from the chorio-allantoic membranes of infected eggs, were distributed into tubes containing equal quantities of the unheated, undiluted serum under test. The serum-virus mixtures were inoculated intraperitoneally into suckling mice, and the results were read by comparison with a normal rabbit serum control which was included at each time of testing. Neutralization of 50 mouse LD<sub>50</sub> was regarded as a positive result. All the neutralization tests, with the exception of the tests on the 11 young horses mentioned in Table IV, were performed by this method.

In the second series the method described by McLean and Stevenson (1954) was followed. As the tests were designed to determine the absence or presence of significant amounts of antibody, and not the actual amount present, only one dilution of virus, calculated to give an estimated 100 mouse LD<sub>50</sub> of virus in the test mixture, was used.

TABLE I.

Complement-Fixation Tests on Horse Sera, 1951 to 1955.

| Source.             | Year.                     | Number of Specimens. | Negative Results. | Positive Results: Titre. |       |
|---------------------|---------------------------|----------------------|-------------------|--------------------------|-------|
|                     |                           |                      |                   | 1:5 to 1:10              | >1:10 |
| Mornington Island   | 1951                      | 26                   | 13                | 6                        | 7     |
| Townsville          | 1951                      | 21                   | 3                 | 9                        | 4     |
|                     | 1953 to 1955              | 39                   | 21                | 18                       | —     |
| Southern Queensland | 1951 to 1952 <sup>1</sup> | 47                   | 41                | 5                        | 1     |
|                     | 1953 to 1955              | 70                   | 74                | 5                        | —     |

<sup>1</sup> The 1951 to 1952 tests were carried out by Dr. S. G. Anderson.

species of birds (*Gallus domesticus*, *Notophox novae-hollandiae*, *Lobibyx novae-hollandiae*, *Kakatoë sanguinea*, *Grallina cyanoleuca*). It was evident that the virus had been prevalent in the area, although the clinical picture was obscured by the concurrent presence of poliomyelitis (M. J. Mackerras, 1951, 1952). As Mornington Island was too inaccessible, a search was made for an eastern centre, where surveys of mosquitoes for infection with the virus might be practicable. Equine serum from Townsville, Bundaberg, Wynnum and Ipswich was sent to Anderson. His results (Table I) indicated that infection had been active at Townsville, but not to a significant degree further south.

It has been suggested by Miles and Howes (1953) and by Anderson and Eagle (1953) that Murray Valley encephalitis is enzootic in northern Australia, and is able to spread south only under special conditions. Beech *et alii* (1953) and Miles and Dane (1956) have searched for enzootic or endemic areas in the Northern Territory, and have found evidence of recent infection in aborigines and domestic fowls.

The original purpose of the present work was to discover whether there were persistent foci of infection in Queens-

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The specimens of serum from the 11 young horses were tested by this method; 23 other specimens were tested by both methods. The two methods gave identical results, except in one instance, in which the result was regarded as positive by the first method and equivocal by the second.

#### Murray Valley Encephalitis Investigations.

##### Horse Sera.

Complement-fixing antibodies were found in 100 of the 243 equine sera recorded in Table III. The horses giving

is very similar to that (8%) in the Innisfail human series, and neutralization tests on three of the "positive" sera gave negative results (Table V). Thus, the southern Queensland horses may serve, in general terms, as a negative control for comparison with the other equine groups. In all these groups, except that from north-west Queensland, the proportion of positive results at a titre of at least 1:5 is significantly greater than in southern Queensland, which suggests that there had been actual stimulation of Murray Valley encephalitis antibodies.

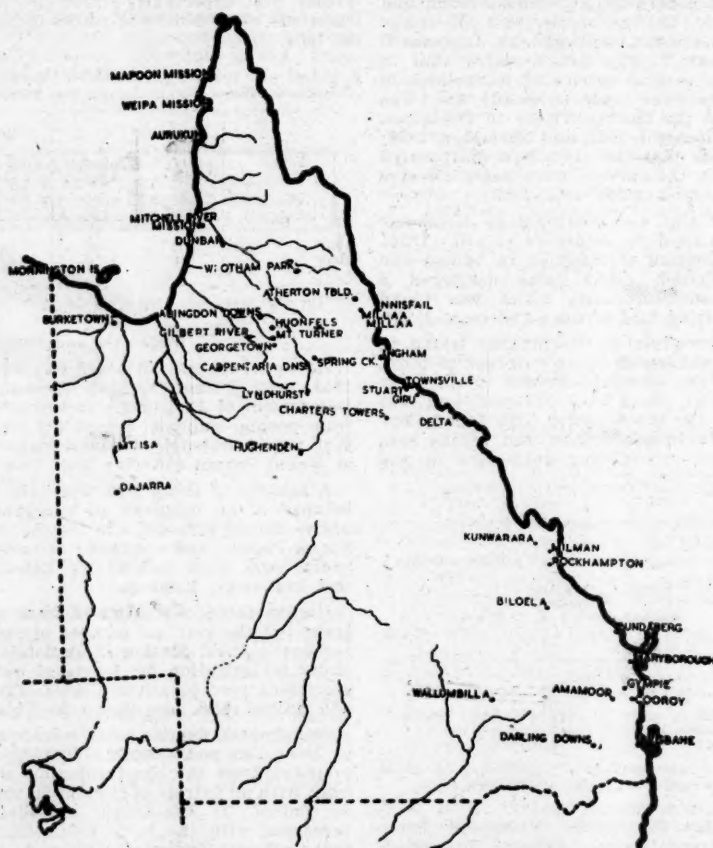


FIGURE I.

positive results came from many places in North Queensland, as well as from coastal districts in central and southern Queensland. The highest incidence of positive results (80%) and the highest titres (1:40) came from the vicinity of the Gilbert and Einarleigh Rivers. The incidence is significantly higher than that in any other area listed in Table III. Nearly half the sera from Cape York, Townsville and central Queensland gave positive results, but the percentage of positive results from southern Queensland was quite low.

It will be noted later that, among 145 samples of human serum taken at Innisfail at a time when there was no evidence of the presence of Murray Valley encephalitis or dengue, two samples fixed complement at a titre of 1:10, and 10 samples at 1:5. It appears, therefore, that fixation of complement in these titres in an occasional case is not sufficient evidence to indicate the activity of a virus of the Murray Valley encephalitis groups. Among the 79 southern Queensland horses there were no strongly positive findings; the proportion of positive results at 1:10 and 1:5 (6%)

Miles (1954) has stated that the complement-fixation test alone cannot be used to differentiate recent from remote infections in humans, but if large numbers of sera are examined, the ratio between those giving positive results to the complement-fixation test and those giving positive results by neutralization may give an idea when the outbreak occurred. However, the very high proportion of positive results, including occasional high titres, from horses near the Einarleigh area suggests that they have been associated with the virus at a later date than the coastal animals, whose titres were lower.

The finding of antibodies in the serum of nine of 14 horses aged under four years (Table IV) provides further evidence that the virus had been present in this area since 1951. One of the horses giving positive results came from the nearby Mitchell River. Two horses from Spring Creek, where the highest titres were found, were aged only fifteen months when examined in May, 1955; this indicates that infection had occurred between this date and early 1954. These results were confirmed by neutralization tests.



TABLE III.  
Complement-Fixation Tests on Horse Sera, 1953 to 1955.

| Source.                             | Number of Specimens. | Negative Results. | Positive Results: Titre. |       |       |       | Percentage of Positive Results. |
|-------------------------------------|----------------------|-------------------|--------------------------|-------|-------|-------|---------------------------------|
|                                     |                      |                   | 1:5.                     | 1:10. | 1:20. | 1:40. |                                 |
| Cape York area:                     |                      |                   |                          |       |       |       |                                 |
| Mapoon Mission                      | 7                    | 3                 | 2                        | 2     | —     | —     | 43                              |
| Welpa Mission                       | 5                    | 3                 | 2                        | 1     | —     | —     |                                 |
| Aurukun Mission                     | 7                    | 6                 | 1                        | 3     | —     | —     |                                 |
| Mitchell River Mission              | 6                    | 2                 | 1                        | 3     | —     | —     |                                 |
| Dunbar                              | 8                    | 6                 | —                        | 2     | —     | —     |                                 |
| Wrotham Park                        | 4                    | 1                 | 2                        | —     | 1     | —     |                                 |
| Gilbert and Einasleigh Rivers area: |                      |                   |                          |       |       |       |                                 |
| Abingdon Downs                      | 3                    | 1                 | 1                        | 1     | —     | —     | 80                              |
| Gilbert River                       | 5                    | 1                 | —                        | 4     | —     | —     |                                 |
| Huonfels                            | 12                   | 4                 | 3                        | 5     | —     | —     |                                 |
| Mount Turner                        | 12                   | 2                 | 1                        | 5     | —     | —     |                                 |
| Georgetown                          | 5                    | —                 | 1                        | 4     | —     | —     |                                 |
| Spring Creek                        | 13                   | 2                 | 2                        | 6     | 1     | 2     |                                 |
| Carpentaria Downs                   | 9                    | 3                 | 4                        | 2     | —     | —     |                                 |
| Lyndhurst                           | 7                    | —                 | 1                        | 4     | 2     | —     |                                 |
| Townsville area:                    |                      |                   |                          |       |       |       |                                 |
| Townsville                          | 20                   | 10                | 9                        | 1     | —     | —     | 46                              |
| Stuart                              | 6                    | 6                 | —                        | 2     | —     | —     |                                 |
| Giru                                | 5                    | 5                 | —                        | —     | —     | —     |                                 |
| Charters Towers                     | 4                    | —                 | 2                        | —     | —     | —     |                                 |
| Delta                               | 4                    | —                 | 3                        | 1     | —     | —     |                                 |
| North-West Queensland:              |                      |                   |                          |       |       |       |                                 |
| Mount Isa                           | 2                    | 2                 | —                        | —     | —     | —     | —                               |
| Dajarra                             | 3                    | 3                 | —                        | —     | —     | —     |                                 |
| Central Queensland:                 |                      |                   |                          |       |       |       |                                 |
| Kunwarara                           | 13                   | 6                 | 3                        | 4     | —     | —     | 47                              |
| Milman                              | 4                    | 3                 | 1                        | —     | —     | —     |                                 |
| Southern Queensland:                |                      |                   |                          |       |       |       |                                 |
| Bundaberg                           | 21                   | 21                | —                        | —     | —     | —     | 6                               |
| Maryborough                         | 14                   | 13                | 1                        | —     | —     | —     |                                 |
| Gympie                              | 18                   | 15                | 2                        | 1     | —     | —     |                                 |
| Amamoor                             | 3                    | 2                 | 1                        | —     | —     | —     |                                 |
| Cooroy                              | 1                    | 1                 | —                        | —     | —     | —     |                                 |
| Darling Downs                       | 22                   | 22                | —                        | —     | —     | —     |                                 |

The anomalous result is unexplained in the case of a young horse from the Aurukun Mission, aged three months, which possessed neutralizing antibodies but no complement-fixing antibodies.

The incidence of antibodies and the titres found in the Townsville sera may be compared with the results obtained

"positive" by the neutralization test, with the exception of the three from southern Queensland; this provides additional evidence that the positive results in northern horses were due to contact with the Murray Valley encephalitis virus.

TABLE V.  
Comparison of Complement-Fixation and Neutralization Tests on Horse Sera.

TABLE IV.  
Results of Complement-Fixation and Neutralization Tests on Young Horses from the Cape York Peninsula Area, 1955.

| Source.                | Date.           | Age of Horse. | Reciprocal of Complement-Fixation Titre. | Neutralization Test Result. |
|------------------------|-----------------|---------------|--|-----------------------------|
| Mount Turner           | May, 1955.      | 3 years.      | 10                                       | —                           |
| Huonfels               | May, 1955.      | 2 years.      | 10                                       | Positive.                   |
| Huonfels               |                 | 3 years.      | 5  | Positive.                   |
| Huonfels               |                 | 3 years.      | 10                                       | Positive.                   |
| Gilbert River          | May, 1955.      | 3 months.     | Negative.                                | Positive.                   |
| Georgetown             | May, 1955.      | 2 years.      | 10                                       | Positive.                   |
| Spring Creek           | May, 1955.      | 15 months.    | Negative.                                | —                           |
| Spring Creek           |                 | 15 months.    | 10                                       | Positive.                   |
| Spring Creek           |                 | 18 months.    | 10                                       | Positive.                   |
| Abingdon Downs         | December, 1955. | 3 years.      | Negative.                                | —                           |
| Mitchell River Mission | December, 1955. | 3 years.      | 10                                       | Positive.                   |
| Aurukun Mission        | December, 1955. | 3 months.     | Negative.                                | Positive.                   |
| Mapoon Mission         | December, 1955. | 34 years.     | Negative.                                | Negative.                   |

| Source.                             | Complement-Fixation Titre Reciprocals. | Neutralization.     |
|-------------------------------------|--|---------------------|
| Gilbert and Einasleigh Rivers area: |  |                     |
| Spring Creek                        | 20, 5, 40, 40, 10, 10, —               | +, +, +, +, +, +, — |
| Carpentaria Downs                   | —, —, 5                                | —, —, +             |
| Lyndhurst                           | 20, 20                                 | +, +                |
| Townsville area:                    |  |                     |
| Townsville                          | —, 5, 5, 10, 5                         | +, +, +, +, +       |
| Stuart                              | —, —                                   | —, —                |
| Charters Towers                     | 5, 5                                   | +, +                |
| Central Queensland:                 |  |                     |
| Milman                              | —, 10                                  | +, +                |
| Southern Queensland:                |  |                     |
| Gympie                              | 5, 5, 10                               | —, —, —             |

#### Other Animal Sera.

by Anderson in 1951 (Table I). On these figures the decline in antibodies is significant. It is likely that the antibodies found in Townsville in the present survey had their origin in the 1951 outbreak.

Neutralization tests were carried out on a number of sera in which complement-fixing antibodies had been found, and occasionally on "negative" or "doubtful" sera (Table V). Sera giving positive results by the tube test were

Complement fixation tests were also carried out on 28 bovine, 21 ovine, eight canine, 11 bandicoot and five rat sera, and on a collection made in 1945 from native animals of the Atherton Tableland. No complement-fixing antibodies were detected in any of these sera (Table VI). Anderson *et alii* (1952) found antibody in canine and possum (*Trichosurus vulpecula*) sera; but these specimens were taken in northern Victoria shortly after the human cases occurred. The 15 possum sera in the present series were collected in 1945, when there was no indication of the presence of encephalitis.

*Human Sera: Burketown, Mornington Island, Mapoon Mission and Brisbane.*

After outbreaks of sickness among aborigines in Burketown during October, 1953, six specimens of serum were sent for examination by the complement-fixation test. Two positive results were found; one specimen had a titre of 1:10, the other a titre of 1:5. Shortly afterwards, in December, 1953, 11 specimens of serum were collected from Mornington Island aborigines, and on examination one positive titre of 1:5 was discovered. The Mornington Island results appear in Table II with the 1951 results. Neutralizing antibodies were also found in these three "positive" sera. These low-titre antibodies probably represent the declining antibodies from the 1951 Mornington Island epidemic, in which 47 of 107 patients possessed antibodies.

TABLE VI.  
Complement-Fixation Tests on Animal Sera Other than Horse.

| Animal.   | Source.  | Number Examined, All Results Negative. |
|---|--|--|
| <i>Bos taurus</i> . . .                           | Millaa Millaa, Innisfail, Ingham, Charters Towers and Hughenden. | 28                                     |
| <i>Ovis aries</i> . . .                           | Walmubilla.  | 21                                     |
| <i>Canis familiaris</i> . . .                     | Innisfail.   | 8                                      |
| <i>Thylacine obesus</i> (bandicoot)               | Atherton Tableland, Innisfail.                                   | 18                                     |
| <i>Perameles nasuta</i> (bandicoot)               | Atherton Tableland.  | 2                                      |
| <i>Trichosurus vulpecula johnstonii</i> (possum). | Atherton Tableland.  | 15                                     |
| <i>Epiprymnus rufescens</i> (kangaroo rat).       | Atherton Tableland.  | 5                                      |
| <i>Dasyurus</i> sp. (spotted cat)                 | Atherton Tableland.  | 1                                      |
| <i>Melomys titoralis</i> (rat)                    | Innisfail.   | 5                                      |
| <i>Hydromys longmani</i> (water rat).             | Atherton Tableland.  | 1                                      |

Two specimens of serum were also received from a person at Mapoon Mission, where an outbreak of mild fever had occurred in August, 1954. The first, which had a titre of 1:10, was taken five months after illness, and the second, with a titre of 1:5, another month later. Both sera gave negative results to neutralization tests.

In response to our requests to hospitals in Brisbane for serum from persons with encephalitis, nine specimens were received for examination between October, 1953, and November, 1955. One gave a positive result, with a titre of 1:5.

It does not appear that the Murray Valley encephalitis virus caused any of the illnesses investigated in Queensland since 1951.

**Dengue Investigations.**  
*Townsville.*

When an outbreak of disease, soon shown to be dengue fever, occurred in Townsville during February, 1954, paired sera from 17 patients and one specimen of convalescent serum were received from Dr. R. A. Rimington. All were examined by the Murray Valley encephalitis complement fixation test, and by neutralization when there was sufficient serum. The results are shown in Table VII.

In eight patients a striking rise was demonstrated in complement-fixing antibodies, the convalescent titres reaching 1:80 and 1:640. The titre in the single convalescent serum was 1:640. In one patient the titre in the convalescent serum was 1:5, and the remaining eight gave completely negative results. Only two sera contained neutralizing antibodies.

*Innisfail.*

As the Townsville investigations showed that half the dengue patients produced complement-fixing antibodies against the Murray Valley encephalitis virus, sera of fever patients from the Institute's Field Station at Innisfail were examined to extend these findings. Although dengue did not appear around Innisfail until March, 1954, sera from patients before this date were included for com-

parison with the later series. Between March, 1953, and July, 1955, specimens from 338 patients were examined (Table VIII). On clinical grounds 72 of these were diagnosed as suffering from dengue, and the remaining 266 were considered to have respiratory tract infections or fevers of doubtful origin.

Of 72 patients with clinical dengue, 26 had complement-fixing antibodies in high titre. This result is similar to that found in the Townsville series. Fourfold rises in titres were demonstrated in the serum of 16 patients, while lesser rises were found in seven others. Table IX shows that high titres were most consistently found from the seventeenth to the twenty-eighth day, although one serum had a titre of 1:320 113 days after the onset. Titres of 1:20 or higher were demonstrated in the serum of six persons in the first week of the disease. No neutralizing antibody

TABLE VII.  
Results of Serological Examinations of Serum from 18 Dengue Patients, Townsville, 1954.

| First Specimen.                          |                             | Second Specimen.                         |                             |
|--|-----------------------------|--|-----------------------------|
| Reciprocal of Complement-Fixation Titre. | Neutralization Test Result. | Reciprocal of Complement-Fixation Titre. | Neutralization Test Result. |
| Negative result.                         | Negative.                   | Negative result.                         | Negative.                   |
| Negative result.                         | Negative.                   | 320                                      | Negative.                   |
| Negative result.                         | Negative.                   | 5  | Negative.                   |
| Negative result.                         | Negative.                   | Negative result.                         | Negative.                   |
| Negative result.                         | Negative.                   | Negative result.                         | Negative.                   |
| Negative result.                         | Negative.                   | 320                                      | Negative.                   |
| Negative result.                         | Negative.                   | Negative result.                         | Negative.                   |
| Negative result.                         | —                           | 640                                      | Negative.                   |
| 5  | Positive.                   | 640                                      | Positive.                   |
| 10                                       | Negative.                   | 320                                      | Negative.                   |
| Negative result.                         | Negative.                   | 320                                      | Negative.                   |
| 5  | Negative.                   | 80                                       | Negative.                   |
| 10                                       | Negative.                   | 640                                      | Negative.                   |
| Negative result.                         | —                           | Negative result.                         | Negative.                   |
| Negative result.                         | Negative.                   | Negative result.                         | Negative.                   |
| Negative result.                         | Negative.                   | 640                                      | Negative.                   |
| Negative result.                         | —                           | Negative result.                         | Negative.                   |

for the Murray Valley encephalitis virus was detected in the serum of 10 patients examined.

None of 75 patients before March, 1954, produced a complement-fixing titre as high as 1:20 (Table VIII). Five patients after that date among the 191 not diagnosed as suffering from dengue had titres of 1:20 or higher. As the clinical diagnosis of dengue can be difficult, dengue is not excluded in these cases. Table VIII also shows that titres of 1:5 and 1:10 were found occasionally in all three groups of patients. Before March, 1954, they cannot be explained by infection with the dengue virus, and the incidence after that date was almost exactly the same as before it. The absence of neutralizing antibodies to Murray Valley encephalitis virus in 15 of these "positive" sera suggests that the positive results were not due to old infection with this virus. As indicated earlier, these low titres cannot be accepted as specific, unless their incidence in the population is significantly higher than about 10%.

*Rockhampton and Biloela.*

After the spread of dengue from north to central Queensland, paired sera were received from four patients at Biloela, and single sera from five at Rockhampton. Table X shows that complement-fixation tests on the Biloela cases gave positive results, with rising titres. The high titres in the first specimens of serum are in accord with their being taken late. No neutralizing antibodies were detected in any of the sera examined. Three of five specimens of serum from Rockhampton gave positive results by complement fixation (titres 1:20, 1:40, 1:320).

**Discussion.**

Complement-fixation tests on equine sera taken between September, 1953, and December, 1955, showed that antibodies were present in a large proportion of North Queensland horses, particularly from the vicinity of the Gilbert

TABLE VIII.  
Results of Complement-Fixation Tests on Innisfail Patients, 1953 to 1955.

| Group.                       | Number of Patients. | Number of Specimens. | Negative Results. | Positive Results: Titre. |      |                 |
|------------------------------|---------------------|----------------------|-------------------|--------------------------|------|-----------------|
|                              |                     |                      |                   | 1:5                      | 1:10 | 1:20 or Higher. |
| Patients before March, 1954: | 75                  |                      |                   |                          |      |                 |
| Serum taken in first week    |                     | 56                   | 49                | 6                        | 1    | —               |
| Serum taken after first week |                     | 89                   | 84                | 4                        | 1    | —               |
| Patients after March, 1954:  | 72                  |                      |                   |                          |      |                 |
| (a) Clinical dengue          |                     |                      |                   |                          |      |                 |
| Serum taken in first week    |                     | 80                   | 46                | 8                        | —    | 6               |
| Serum taken after first week |                     | 79                   | 34                | 12                       | 4    | 20              |
| (b) Various fevers           | 191                 |                      |                   |                          |      |                 |
| Serum taken in first week    |                     | 155                  | 143               | 11                       | 1    | —               |
| Serum taken after first week |                     | 202                  | 181               | 12                       | 4    | 5               |

and Einasleigh Rivers. Beech *et alii* (1953) have examined sera from aborigines in the Northern Territory, and found that a high percentage contained antibody against the Murray Valley encephalitis virus. They suggested that Murray Valley encephalitis might be endemic in certain areas where the highest incidence occurred, notably in the high rainfall region south of Darwin. The present examination of equine sera suggests that the Gilbert and Einasleigh Rivers area, which has an average yearly rainfall of 27 inches, and where water birds are plentiful, may be another region containing endemic foci; but its distance from Brisbane and inaccessibility have prevented further investigations. The presence of neutralizing and complement-fixing antibodies in the sera of young horses from this area provides additional evidence that the virus has been present later than 1952, probably in the summer of 1953-1954, the incidence and titres being comparable with those found at Mornington Island and Townsville in 1951.

The presence of high titre complement-fixing antibodies to the Murray Valley encephalitis virus was demonstrated in 42 of 99 dengue cases from four areas in northern and central Queensland. Most of these showed a rising titre, often to a level of 1:320. Another interesting feature, showing the rapidity of antibody production, was the number of positive results in the "acute" sera taken quite early after onset. Rowan and O'Connor (personal communication), investigating the outbreak in Townsville and Innisfail, have also found cross-reaction of dengue sera with the Murray Valley encephalitis virus, and in some cases with that of West Nile fever. In practice, the identification of dengue was aided by the use of the complement fixation test with Murray Valley encephalitis antigen, a dengue antigen not being available at the time. As less than half the patients gave positive results, its value was

greater in investigating the outbreaks than in diagnosing individual cases.

In the dengue investigations the neutralization test gave anomalous results in two out of a total of 64 sera tested. These two cases are probably explained by the converse of Smithburn's findings that Murray Valley encephalitis human serum contained neutralizing antibody against the dengue virus. In future investigations, the main function of the neutralization test would be to differentiate true Murray Valley encephalitis antibody from dengue antibody in a serum survey, when positive results were obtained by complement fixation.

#### Summary.

Complement-fixing antibodies for Murray Valley encephalitis antigen were found in the serum of 100 of 243 Queensland horses. The highest incidence (80%) and the highest titres (1:40) were found in horses from the Gilbert and Einasleigh Rivers area. Neutralizing antibodies were found in northern and central Queensland horses, but not in southern Queensland horses. Thus, the Murray Valley encephalitis virus, or some closely allied virus, has had a wide distribution in tropical Queensland.

Murray Valley encephalitis has apparently disappeared from the Townsville area, and it had returned, or possibly persisted, in the Gilbert and Einasleigh Rivers area at least as late as 1954.

Serological evidence of old infection with Murray Valley encephalitis was found in three of 17 aborigines from Burketown and Mornington Island.

A fourfold rise in complement-fixing antibodies for Murray Valley encephalitis antigen developed in the convalescent serum of between one-third and one-half of the

TABLE IX.  
Results of Serological Examinations of Serum from 19 Innisfail Patients after March, 1954.

| Patient. | First Specimen.  |  |                             | Second Specimen. |  |                             |
|----------|------------------|--|-----------------------------|------------------|--|-----------------------------|
|          | Days from Onset. | Reciprocal of Complement-Fixation Titre. | Neutralization Test Result. | Days from Onset. | Reciprocal of Complement-Fixation Titre. | Neutralization Test Result. |
| A.       | 2                | Negative result.                         | —                           | 17               | 320                                      | —                           |
| B.       | 3                | Negative result.                         | —                           | 17               | 160                                      | Negative.                   |
| C.       | 4                | 80                                       | —                           | 19               | 320                                      | —                           |
| D.       | 2                | Negative result.                         | —                           | 20               | 320                                      | —                           |
| E.       | 2                | Negative result.                         | —                           | 22               | 320                                      | —                           |
| F.       | 5                | Negative result.                         | —                           | 23               | 320                                      | —                           |
| G.       | 2                | Negative result.                         | Negative.                   | 25               | 160                                      | Negative.                   |
| H.       | 5                | 5  | Negative.                   | 25               | 20                                       | Negative.                   |
| I.       | 9                | Negative result.                         | —                           | 28               | 160                                      | Negative.                   |
| J.       | 5                | 40                                       | Negative.                   | 29               | 80                                       | —                           |
| K.       | 2                | 5  | —                           | 31               | 320                                      | —                           |
| L.       | 2                | 5  | —                           | 31               | 20                                       | —                           |
| M.       | 4                | Negative result.                         | —                           | 39               | 320                                      | Negative.                   |
| N.       | 3                | Negative result.                         | —                           | 48               | 20                                       | Negative.                   |
| O.       | 3                | 80                                       | Negative.                   | 49               | 10                                       | —                           |
| P.       | 10               | 20                                       | Negative.                   | 71               | 10                                       | Negative.                   |
| Q.       | 4                | 40                                       | Negative.                   | 81               | 320                                      | —                           |
| R.       | 19               | 80                                       | —                           | 113              | 320                                      | —                           |
| S.       | 2                | Negative result.                         | —                           | 121              | 20                                       | —                           |



patients suffering from dengue. Neutralizing antibodies to Murray Valley encephalitis virus were rarely found in the serum of dengue patients.

The complement-fixation test, therefore, is useful in surveys for dengue fever; but the neutralization test must be employed when evidence of Murray Valley encephalitis infection is to be sought in human serum in northern and central Queensland.

TABLE X.

Results of Serological Examination of Serum from Dengue Patients at Bilcoala.

| First Specimen.                          |                             | Second Specimen.                         |                             |
|--|-----------------------------|--|-----------------------------|
| Reciprocal of Complement-Fixation Titre. | Neutralization Test Result. | Reciprocal of Complement-Fixation Titre. | Neutralization Test Result. |
| 320                                      | —                           | 640                                      | Negative.                   |
| 80                                       | —                           | 640                                      | Negative.                   |
| 320                                      | —                           | 640                                      | Negative.                   |
| 320                                      | Negative.                   | 640                                      | Negative.                   |

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### THE COMBINATION OF TRICHLOROETHYLENE GENERAL ANÆSTHESIA WITH SURFACE ANÆSTHESIA FOR THE PURPOSE OF BRONCHOGRAPHY.

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MANY techniques have been described for the performance of bronchographic examinations under general anaesthesia in young children, in non-cooperative older children or in excessively nervous adults, by means of which good bronchograms may be safely obtained.

In 1951 William Mushin and Roger Lake described a method in which bromethol narcosis was combined with cocaine surface anaesthesia, while a fine catheter passed through the vocal cords was used to instill radio-opaque oil. The procedure to be discussed in this paper is a variation in the application of the above method, in that trichloroethylene general anaesthesia is used instead of bromethol narcosis.

#### Method.

Before operation the lungs are made as sputum-free as possible by postural drainage and coughing. Atropine is given orally two hours before operation or intravenously immediately before operation. Anaesthesia is induced with a minimal intravenous dose of hexobarbitone, followed by inhaled ethyl chloride, then trichloroethylene till light stage III anaesthesia is achieved. In young children in whom an intravenous injection is not practicable, the anaesthetic is commenced with ethyl chloride followed by trichloroethylene. A laryngoscopic examination is performed, the trachea and larynx are sprayed with a 0.5% solution of amethocaine with "Neo-Synephrine" (1 in 2000), and a fine catheter is passed through the nose and guided under vision into the trachea. A pharyngeal airway with a side-arm is placed in the mouth and connected by six feet of tubing to an anaesthetic machine, from which six litres of trichloroethylene vapour in oxygen are insufflated. The patient is turned onto the right side, when one cubic centimetre of the amethocaine solution is instilled through the catheter. This produces surface anaesthesia of the trachea and right lung. After two minutes this is repeated on the left side. If one suspects that bronchial secretions are present, suction may be applied to the catheter. This must be carefully done. If the depth of anaesthesia is adequate, respiration continues without the development of negative pressure in the lungs.

Posturing and instillation of oil are carried out at the radiologist's direction. The length of rubber tube permits the continuous administration of oxygen and trichloroethylene. X-ray photographs are taken during the expiratory pause. Should respiration be too rapid for convenient radiographic examination, slowing may be brought about by the intravenous injection of a small dose of pethidine. Ten milligrammes would be a suitable dose for a child aged five years.

At the conclusion of the procedure, as much of the oil as possible is aspirated, and the patient is placed on the side with the head dependent, or prone over a pillow. Within five to ten minutes the cough reflex returns and unconsciousness merges into sleep.

### Discussion.

The establishment of surface anaesthesia contributes largely to the smooth progress of the procedure. The quick return of the cough reflex at the conclusion suggests that the surface anaesthesia has then largely ceased to act effectively. The writer believes that for all procedures involving the larynx or tracheo-bronchial tree performed under general anaesthesia, effective surface anaesthesia is needed irrespective of the means whereby general anaesthesia is obtained.

The use of a bronchodilator with the local anaesthetic lessens the tendency to troublesome bronchospasm, which otherwise may occur. However, this addition does not produce the appearance of bronchiectasis in a normal lung.

### Dangers.

Bronchography is a major procedure, especially in small children, and should be undertaken only when indicated after clinical examination and radiographic examination without the use of an opaque medium.

The dangers arise from the general anaesthesia, the surface anaesthesia and the instilled oil. With care the dangers arising from the general anaesthesia and the local anaesthetic agent should not be great.

Excessive quantities of oil can reduce respiratory exchange. Idiosyncrasy to the iodine compound is not easily tested before operation. It is suggested that the minimum quantity of oil be used consistent with obtaining satisfactory results, and that for small or very ill patients the procedure should be carried out in two stages, one at a time, with some weeks intervening.

As an added safety precaution, a preliminary "straight" film should be taken and developed before the induction of general anaesthesia is begun. This will exclude pneumonia, lobular collapse and pneumothorax, which are often not easily diagnosed clinically.

### Summary.

1. A method of using trichloroethylene general anaesthesia for bronchography, together with surface anaesthesia of the larynx and tracheo-bronchial tree, is described.

2. The dangers of the procedure are mentioned. As little oil as possible should be used. If the child is small or very ill the procedure should be carried out in two stages, on one lung at a time with several weeks intervening.

### Acknowledgements.

The patients in this series were anaesthetized for the following radiologists (in alphabetical order): Dr. P. Davis, Dr. H. J. Hosking, Dr. J. O'Sullivan, Dr. Gwynne Villiers, and Dr. B. Wood. All of them showed commendable patience and cooperation.

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## IRRADIATION IN THE TREATMENT OF ANOVULATION.

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ANOVULATION may be encountered as a causative factor in cases of sterility. Unfortunately the treatment of this condition is far from satisfactory (Buxton and Southam, 1956). Many measures, including general medical care and endocrine therapy, have been tried, but the results have been disappointing. Low-dosage irradiation will be shown to produce a favourable response when the above-mentioned measures have failed.

This paper presents the results obtained in a series of cases of anovulation treated by low-dosage irradiation to the pituitary and ovaries and considers briefly the mode of action, indications, contraindications and dangers of irradiation.

Fifty years have elapsed since the therapeutic value of irradiation was first noted by Halberstaedter. Shortly afterwards, Bécélère reported the resumption of menstruation after the use of X-ray therapy in cases of pituitary abnormality. Since then many have written on the subject of irradiation, Kaplan and Israel (1954) showing the value of this method of treatment for sterility due to anovulation.

### Criteria of Anovulation.

The following investigations will reveal the presence of anovulation. (i) Basal temperature chart. This will show a typical monophasic pattern, as distinct from the biphasic character obtained with ovulation. (ii) Endometrial biopsy. The endometrium obtained from a premenstrual biopsy is proliferative and not secretory in nature. (iii) Cervical mucus arborization. The persistence of the cervical mucus arborization in the second half of the cycle is confirmatory evidence of anovulation (Urdan and Kurzon, 1955). Progesterone activity, which is absent in cases of anovulation, inhibits the above-mentioned phenomenon, which is due to oestrogen stimulation.

### Mode of Action of Irradiation.

The mode of action of irradiation in restoring ovarian function is not as yet fully understood, and this has deterred many people from using it.

There are two main theories of action (Israel, 1954). The first is that irradiation produces hyperaemia and causes changes in the chemical enzyme system and cell structure. According to the second, the effect is due to the removal of some inhibitory influence on normal glandular activity.

### Indications for Irradiation.

The following are the indications for irradiation. (i) The patient is desirous of pregnancy. (ii) Anovulation is the only known factor in the sterility. (iii) General medical and endocrine therapy have been unsuccessful during the preceding twelve months.

### Dosage.

The patients in this series were treated with a total depth dose of 180r to the ovaries and 75r to the pituitary, given in three divided doses over a period of fourteen days.

### Results.

Thirty-five patients were treated by irradiation to the ovaries and the pituitary with the technique described. All had failed to respond to other methods of treatment. Two patients could not be traced, leaving a total of 33 known patients treated during the years 1945 to 1954. These were distributed as follows: 1954, 10 patients; 1953, three; 1952, three; 1951, one patient; 1950, two patients; 1949, four; 1948, three; 1947, six; 1945, one patient. Irradiation treatment was regarded as successful if ovulation occurred within six months of treatment (Israel, 1954). Of the 33 patients, 16 showed definite evidence of ovulatory basal temperature charts within this time; 17 did not.

The interval from treatment to response was as follows: one to three months, 11 patients; four to six months, five patients. It can be seen that more than half the patients showed evidence of ovulation in the first three months.

The commencement of the first pregnancy in relation to the treatment was as follows: one to three months, four patients; four to six months, four patients; seven to twelve months, five patients. During the first six months there were eight pregnancies, and in the second six months there were five.

The total number of pregnancies was 25; they resulted in 19 full-time deliveries, one premature labour at twenty-nine weeks, one fetal death *in utero*, and four miscarriages in the first trimester.



In the case of the premature labour, the child lived for five days, and post-mortem examination failed to reveal any macroscopic evidence of fetal abnormality. The fetal death *in utero* occurred in a patient with gross hypertension, the blood pressure reading on one occasion being 240 millimetres of mercury, systolic, and 150, diastolic. One of the patients who miscarried has had one normal full-time baby, and a second has had two such babies.

These results compare favourably with the report of Ingalls, Larson and Rothnem (1955).

Failure to respond to irradiation was noted in 17 patients. In one of these, menopausal symptoms developed.

#### Report of a Case.

The following history illustrates a typical response to irradiation therapy.

Mrs. A., aged thirty years, was examined on October 1, 1953. She had been married for ten years, and said that she had been trying to conceive throughout this time. The menstrual history revealed that the cycles were irregular, varying from five to six weeks, and there was only slight loss for two to three days. General medical and pelvic examinations revealed no abnormality. The following investigations were performed.

On October 27 Rubin's test produced a positive result at a pressure of 180 millimetres of mercury. The administration of thyroid tablets, 0.5 grain twice a day, was begun.

On November 3 a semen analysis gave the following results: the volume was 4.1 cubic centimetres, the motility was 65%, abnormal forms amounted to 30%. The total count was 42,000,000.

On November 15 endometrial biopsy was attempted; no endometrium was obtained. On December 24 endometrial biopsy was again attempted. Minute fragments of proliferative endometrium were obtained. The previous menstrual period had occurred on November 18.

On February 11 another endometrial biopsy was attempted, and proliferative endometrium was obtained. A normal menstrual period occurred one week later. Thyroid therapy was discontinued. The administration of tablets of oestrogen compound, each tablet containing 4000 international units of oestrogen, was commenced; the tablets were given twice daily.

On March 11 it was noted that the basal temperature chart for the preceding six months was of the anovulatory type. On May 15 oestrogen therapy was discontinued. On August 17 there was still no evidence of ovulation.

A review of the case at this stage showed repeated anovulatory cycles, despite the use of hormone therapy including thyroid and oestrogens. Tubal patency had been demonstrated by Rubin's test. Analysis of the semen showed it to be somewhat below the normal standard.

It was decided to use irradiation therapy, and this was given during September, 1954. The cycle in October was still anovulatory; but in November a typical ovulatory basal temperature pattern was noted. The patient reported early in February, 1955, that her last menstrual period had commenced on December 12. Examination at this stage confirmed the presence of an early pregnancy, and on October 9 the patient was delivered of a healthy male child weighing seven pounds 11.5 ounces.

#### Contraindications to Irradiation.

The possibility of early pregnancy is the main contraindication to irradiation. Accordingly, therapy is commenced immediately after a normal menstrual period, and the patient is advised to refrain from intercourse during treatment.

#### Dangers of Irradiation.

The main danger of irradiation therapy is considered to be the development of genetic changes in future generations. This view gained credence as a result of experiments performed on animals and plants. Definite evidence of genetic changes was found to follow the use of irradiation in these cases. However, low-dosage irradiation to the pituitary and ovaries has not been shown to be detrimental to humans, provided that the contraindications are clearly understood (Fullenlove, 1956).

Kaplan, in a review of 450 patients over a period of twenty-five years, has followed 14 families through three

generations without any evidence of the development of fetal abnormality. Similar results, though on a smaller scale, have been published by many authors working in this field (Fullenlove, 1956).

The second danger of irradiation is the possible development of ovarian failure. Symptoms of this condition developed in one patient; but since the completion of this series the dosage of irradiation has been reduced to 50r to the ovaries, and there has been no further occurrence of this condition.

#### Summary.

1. Irradiation therapy was employed in the treatment of 33 infertile patients who were found to have anovular menstruation which had failed to respond to medical treatment.

2. Ovulation was demonstrated in 16 patients, and 13 of these became pregnant, the total number of pregnancies being 25.

3. There was no evidence of fetal abnormality in any of the offspring produced.

4. Menopausal symptoms developed in one of the 17 patients who failed to respond to treatment.

#### Acknowledgements.

I wish to acknowledge the assistance of Dr. Gordon Ley, Honorary Medical Officer, Sterility Clinic, The Royal Women's Hospital, Melbourne, in preparing this paper.

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#### Books Received.

[The mention of a book in this column does not imply that no review will appear in a subsequent issue.]

"A Synopsis of Surgical Anatomy", by Alexander Lee McGregor, M.Ch. (Edin.), F.R.C.S. (Eng.); Eighth Edition; 1957. Bristol: John Wright and Sons, Limited. 7 1/2" x 5", pp. 820, with 766 illustrations. Price: 32s. 6d.

The entire book has been revised and part has been rewritten since the previous edition was published in 1950.

"Gout", by John H. Talbott, A.B., M.D., D.Sc. (Hon.); 1957. New York and London: Grune and Stratton. 8 1/2" x 5", pp. 224, with 63 illustrations and 16 plates. Price: \$6.75.

A completely revised version, textually and pictorially, of the author's earlier work, "Gout and Gouty Arthritis", published in 1953.

"The Year Book of Pathology and Clinical Pathology (1956-1957 Year Book Series)", edited by William B. Wartman, B.S., M.D.; 1957. Chicago: The Year Book Publishers, Incorporated. 7 1/2" x 5", pp. 510, with 158 illustrations. Price: \$7.00.

One of the Practical Medicine Series of Year Books.

"Instinct in Man: In the Light of Recent Work in Comparative Psychology", by Ronald Fletcher, B.A., Ph.D.; 1957. London: George Allen and Unwin, Limited. 9 1/2" x 6", pp. 352. Price: 40s.

The author "systematically examines the whole doctrine of human instincts and argues for the reinstatement of the theory of instincts in psychology".



## The Medical Journal of Australia

SATURDAY, AUGUST 31, 1957.

*All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.*

*References to articles and books should be carefully checked. In a reference the following information should be given: surname of author, initials of author, year, full title of article, name of journal, volume, number of first page of the article. The abbreviations used for the titles of journals are those adopted by the Quarterly Cumulative Index Medicus. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.*

*Authors who are not accustomed to preparing drawings or photographic prints for reproduction are invited to seek the advice of the Editor.*

### THE RETIREMENT OF DR. MERVYN ARCHDALL

DR. MERVYN ARCHDALL, who has been Editor of THE MEDICAL JOURNAL OF AUSTRALIA for twenty-seven years, retires today from the editorial chair. He takes with him the respect of those who know his work, the affection of those who know him personally, and the gratitude of the medical profession in Australia. Ill-health has hastened his retirement; since the latter part of last year it has interfered with his taking an active part in the production of the Journal, and since March 1 of this year he has been on long-service leave. His departure from the editorial chair marks the end of a significant period in the history of the Journal.

In 1914 Henry William Armit came from England to take charge of the destinies of THE MEDICAL JOURNAL OF AUSTRALIA, the first journal of the whole medical profession in Australia, just founded by the Australasian Medical Publishing Company Limited. On Armit fell the responsibility for determining the young journal's editorial policy and for moulding it in its formative years. This he did without regular assistance until 1920, when the post of Assistant Editor was established. This post was held for relatively short periods by a succession of men, all of whom have subsequently gained eminence in their profession but in other spheres than medical journalism. In 1922 Mervyn Archdall came to the position, to remain in the service of the Journal, the company and the medical profession for thirty-five years, and to gain eminence in his profession within this most exclusive of specialties. A son of the Rectory, he had been educated at Sydney Grammar School and the University of Sydney, had been

on the resident medical staff of Sydney Hospital, where he came under the influence of such men as Jamieson, Maitland, Corlette and Fiaschi, had then gone into general practice in Queensland and later in the Sydney suburb of Balmain, and subsequently had served with the Australian Imperial Force in France. Keen on surgery, he gained valuable experience on the relieving honorary staff of Sydney Hospital, and this stood him in good stead during his war service when he was on the staff of the Second Australian General Hospital as "second surgeon" to Victor Hurley and later Fay Maclure, and afterwards had charge of a surgical team. After the war, acting on advice, he returned to general practice. In 1922 he applied for the position of Assistant Editor of the Journal, but, it is interesting to note, was not appointed. However, the appointee found that he could not continue in the position, and two weeks later it was offered to Mervyn Archdall. On accepting it he was given a half-time job and began to absorb what the late A. W. Holmes & Court used to call the Armit tradition. He succeeded to the editorship on Armit's sudden death in 1930.

Mervyn Archdall's period as Editor has not been a simple period. It has included the financial depression of the early nineteen-thirties and the world war of 1939-1945, each of which brought to the Journal its peculiar difficulties, editorial and managerial. Moreover, complete lack or insufficiency of editorial assistance, especially in the earlier years, made the task of producing a weekly journal heavy and unrelieved. Nevertheless the Journal has constantly expanded in scope, influence and value. An important factor has been the paying of regular visits to the Branches of the British Medical Association throughout Australia—a practice strongly pressed for by the Editor and approved by the Board of Directors. Its value needs no emphasis. Of importance, too, have been the Editor's journeys overseas: the first in 1938, when a "busman's holiday" included visits to medical journals and organizations in the United Kingdom, the Continent and North America; the second in 1948, when he accompanied the late Sir Archibald Collins as a delegate to the General Assembly of the World Medical Association in Geneva and also attended the British Medical Conference in London; the third in 1954, when he was alternate delegate from Australia at the General Assembly of the World Medical Association in Rome and represented THE MEDICAL JOURNAL OF AUSTRALIA at the world meeting of medical editors. Of long-lasting and constructive importance have been certain aspects of editorial policy which have been pursued vigorously. One has been the maintenance of the Journal's standard at a high scientific level. Another has been an insistence that the results of medical investigations carried out in Australia should be published in Australia and not overseas, a policy which has done much for the status of Australian medicine. The Editor has long had in mind the development, when the time is ripe, of a high-class medical research journal to meet the growing Australian need. This must surely come within the not-too-distant future. Another sound development, which has been essentially an Archdall idea in conception and gestation, is the institution of the Federal Council Medical Monograph Fund. In this, as in the initiation of the New South Wales Branch Prize Essay, the Editor has brought into prominence in a practical way something

which he has never ceased to emphasize—the fact that the *raison d'être* of the British Medical Association, as expressed in its official objects, is firstly to promote the science of medicine and only secondly to pursue medico-political aims.

Although Mervyn Archdall has, both through the Journal and in other ways, served the British Medical Association to the limits of his opportunities and ability, his interest and service have extended much more widely in the medical world. In 1928, with the consent of the Board of Directors, he undertook to edit, in his spare time, the new *Journal of the College of Surgeons of Australasia*, and he continued to edit that journal under its original title and as *The Australian and New Zealand Journal of Surgery* for twenty years. In 1946 he started the *Proceedings of The Royal Australasian College of Physicians*, which in 1952 was expanded into the *Australasian Annals of Medicine*; this has now a complete editorial board, but it is edited in the editorial office of THE MEDICAL JOURNAL OF AUSTRALIA. Another willingly accepted task for the past fourteen years has been the editing of the *Transactions of the Ophthalmological Society of Australia*. For some years it has been the editorial policy of THE MEDICAL JOURNAL OF AUSTRALIA to allot to one issue of the Journal the papers read at the annual meeting of one or other of the special societies within the profession; the reprints prepared from these issues of the Journal have then become the proceedings of the particular society. It is to be noted that the Ophthalmological Society of Australia and the Australian Orthopaedic Association have elected Mervyn Archdall an honorary member. He was elected a Fellow of the Royal Australasian College of Surgeons in 1928 and a Fellow of The Royal Australasian College of Physicians in 1944.

In 1955 the directors of the Australasian Medical Publishing Company Limited, at a special dinner given in his honour, presented to Mervyn Archdall his portrait, painted by Mr. Jerrold R. Nathan. It now hangs in the new board room, the T. W. Lipscomb Room, at The Printing House. The portrait and this leading article are tributes paid during his lifetime (as such tributes should be but all too seldom are paid) to a man of vision, ideals and rare practical ability. In a leading article on "The Death of Henry William Armit", published in this Journal on March 22, 1930, the new Editor wrote:

All men have opportunities of influencing for good or evil those with whom they come into daily contact; their example and precept do not pass unheeded. Medical practitioners have larger opportunities than the majority of other men; they are brought into intimate relationship with the sick and suffering at a time when the minds of the latter are receptive, when force of character can make a lasting impression; they are regarded by those who are not ill, as beings, intensely human, who may be used as a tower of refuge in time of trouble. A medical journalist who loves his profession, has the power and privilege of influencing his *confrères*. His power is the power of the Press, supplemented by a scientific training and by an inherent ethical outlook. Armit regarded privilege and power as sacred.

These words were a tribute to Armit, but those who know Mervyn Archdall can have no doubt that in writing them he revealed his own heart. They are the standards and ideals on which the whole of his editorial life and work has rested. They will remain the standards and ideals of this Journal.

## AN ASTONISHING PHENOMENON.

THE weekly routine of THE MEDICAL JOURNAL OF AUSTRALIA is usually unspectacular. Regularly each week it is published, with its quota of original articles relating to medical work in Australia, and its notes and comments on current medical events and progress. The doctors of Australia, for whom it is primarily intended, look to it to keep them informed and stimulated in their knowledge of medicine and the medical world. It does not attract or expect to attract much outside interest, although it is available to anyone who likes to buy it. The non-medical Press appears to keep an eye on it, and occasionally picks out a tit-bit, garnishes it according to its fancy and adds it to the varied menu with which it seeks to tempt the popular palate—but mostly as a sort of side-dish. Once in a while it finds something particularly acceptable or unacceptable to its taste and whips up an extra piquant dish. The result may be a little extravagant, but no particular harm is done. Never, however, can we remember the Press behaving in such an astonishing fashion as it did after the appearance of the issue of the Journal of August 17.

In the 40 pages of varied reading matter which made up that issue were included two short items. One was a paper by a Sydney psychiatrist, in which he discussed the state of depression that sometimes occurs in patients undergoing treatment with rauwolfia, a phenomenon referred to many times in the Journal over the past couple of years. The other was a note, inserted at the suggestion of a responsible physician on the staff of a teaching hospital after he had discussed it with the State public health authorities, in which attention was drawn to the fact that a virulent staphylococcal infection was complicating an occasional case of influenza. These items were not unimportant; but neither were their contents new. They were timely reminders to practising doctors on matters with which their normal training would have already fitted them to deal. However, they were apparently new to the non-medical Press, as one might expect, and "new" things are news. The result was staggering. Before the Journal had had time to get through the post to its normal readers, the people trained to understand its contents, those contents were hitting the newspaper headlines, and headlines two inches high at that! The whole community found itself under the menacing shadow of "insane pills" and the "Golden Death" (the phrases are incredible, but there they were in bold type headlines), and a first-class scare was under way. Busy senior medical men were being pestered with silly questions at all hours of the day and night by reporters, and equally busy general practitioners were being run off their feet with unnecessary calls from sincerely worried patients. Public health officials were criticized for being reluctant to start a panic, the British Medical Association was criticized for something that was not quite clear, and this Journal was criticized for allegedly not telling the doctors about something that it had in fact been telling them about for over two years. It was quite astonishing.

This Journal and the medical profession of which it is a part have no wish to quarrel with the non-medical Press. The newspapers are an essential part of the life of our community, and we could not do without them. But these



recent incidents have moved many reasonable people to anger and despair. We believe that we have a right to expect something better from our great daily newspapers. The health of the people and the practice of medicine are serious matters; the medical profession as a whole accepts and seeks to carry the heavy responsibility that comes to it; this Journal accepts the responsibility of standing behind the profession which it is its duty to serve. We are only too willing to cooperate in ensuring that the newspapers and the public which it is their duty to serve are kept informed on medical matters of importance. But let us be spared any more of the fatuous nonsense that we have had to endure lately.

## Current Comment.

### HEALTH IN THE HEAVENS.

SCIENCE FICTION has provided us with extraordinary ideas about the physiology of space man, but in the United States many individual scientists, government agencies and private organizations are studying the problems which man will have to contend with if and when he leaves the earth for outer space or even tries to fly at very great heights and very great speeds.

In a special article in *The Journal of the American Medical Association* for June 15, 1957, an account is given of the kinds of observations which are being made and where they are being made. A great deal of work is being done at the Randolph Air Force Base School of Aviation Medicine near San Antonio, Texas. Here they have a large steel chamber in which men can live under conditions such as they would meet with when they reached a certain height in the earth's atmosphere or in outer space. Here are being examined the survival needs of subjects at an altitude at which blood effervesces; tests are made of muscular coordination, vision and blood pressure of subjects in a state in which gravity ceases to act; and many other problems are investigated.

Man has already reached a height of 24 miles in a rocket plane; and, in simulated heights in ground chambers, he has gone up to 38 miles. The fraction of 1% of air at these levels acts as a virtual vacuum upon the unprotected human body. Almost the same conditions would be met with in a journey to Mars. One of the problems to be met in this high flying is the poisonous effect of ozone, which is relatively abundant at some levels. In the tank at Randolph some remarkable things have been done. It automatically controls oxygen intake, carbon dioxide absorption, temperature and humidity. The aim is to recycle wastes into essentials. The tank's urine distillation apparatus produces water which is more potable than many town water supplies. Nitrogen, collected in the distillation process, could nourish algae, which in turn could absorb all the carbon dioxide while supplying oxygen.

An interesting experiment was the imitation, as nearly as possible, of Martian conditions and the effect of this on plant growth. Soil with an iron content approximately that on Mars was placed in bell jars and subjected to an atmosphere containing one-twentieth of the oxygen in the earth's atmosphere at sea-level, of extreme dryness and a pressure of one-tenth that of the earth's atmospheric pressure. The jars were moved back and forth from room temperature to 30° below zero during a simulated Martian day. Blue-green growths, presumably blue-green algae, appeared in some of the jars. These may be similar to the blue-green patches on Mars, believed by many to be vegetation.

The day-and-night cycle will be important with increasing speed of air travel. With a speed of a little over 1000 miles per hour one could leave Paris at local lunch time and arrive in New York at local lunch time. Unless

adjustments can be made in eating and sleeping habits, physiological needs are thrown out of gear.

At a certain height or travelling at certain speeds the effect of gravity can be completely lost. A number of subjects have been put under these conditions for short periods and have found them not unpleasant; what will be the effect of longer times under these conditions is still to be determined, but it is thought that disorientation in such a gravity-free state could have grave implications. It is interesting to note that paratroopers momentarily experience the gravity-free state when falling. Several United States Aviation Medicine schools have created weightless periods for the crews of jet planes of upwards of 47 seconds.

A great many other problems are being studied—for example, "what can be done to counteract empty field myopia, the nearsightedness which is expected to attack even normal eyes in space where there is no reference point for focus?" and "how can we accurately measure in advance the possible genetic hazards of space travel as the result of increased cosmic ray bombardments?". Already it is recommended that commercial airliners should not risk flight above 90,000 feet until it can be shown that there is no danger. A new school of aviation medicine is being set up near San Antonio costing 9,000,000 dollars with 2,000,000 dollars' worth of specially designed atmospheric pressure chambers, refined versions of that at Randolph. The navy is also carrying out extensive work, and many of the aircraft companies are spending large sums of money on similar researches.

It has been claimed by one physiologist that man will be ready for space travel as soon as space ships are ready, and that this will be sooner than most people suspect. This seems an over-optimistic view, but the investigations to determine whether it is possible are being carried out in the United States with increasing tempo.

### RESEARCH ON INSECT RESISTANCE.

An appeal to governments, scientists and industry to intensify research into the global problem of insect resistance has been made by the Technical Conference on Insect Resistance, called together by the World Health Organization in Geneva recently. An international research programme into more than 40 aspects of the puzzling and complex phenomenon of resistance to insecticides, which threatens the control of major diseases, was drawn up by the Conference, which met under the chairmanship of Mr. K. D. Quarterman, of the United States Public Health Service. The members of the Conference, among them directors of the principal research laboratories in Asia, North and South America, Africa and Europe, will collaborate in this programme; they have recommended that the World Health Organization should be enabled to take the lead in the stimulation and coordination of this international undertaking. They point out that the steady increase in the number of insects resistant to insecticides is most alarming for the world's health, and they consider that it would be irresponsible to dismiss the real possibility of a significant increase in the incidence of insect-borne diseases in man.

A report on the conference, issued by WHO, states that in 1946 only two species of insects of public health importance, the housefly and certain kinds of mosquitoes, were resistant to DDT. Today they number 38, among them being several species of malaria-transmitting mosquitoes, plague-carrying fleas and typhus-bearing lice. Countries all over the world have spent huge sums of money to control the great insect-borne pestilences. Faced with the possibility of failure, they have not a single practical solution today for the control of resistant insects, except emergency switching from one insecticide to another. But scientists are running out of effective insecticides which are at the same time economic and non-toxic to man, although chemical firms are testing as many as 50,000 compounds a year for their insecticidal properties.



The world may soon face an emergency, because of the dynamic nature of the resistance problem, as opposed to the more static nature of many other scientific and technical problems. For instance, the problem of the common cold may not be solved within the next ten years, yet it is unlikely to become more serious on that account. The resistance problem, on the other hand, intensifies day by day. The danger resides not only in the steady annual increase in the number of resistant species of insect; the geographical area involved and the number and types of insecticides to which insects have become resistant are also increasing from year to year.

The most pressing need in this race for time against insect resistance is for more and more research, because only research can bring the knowledge and understanding necessary to produce countermeasures against this threat. But present research is inadequate in all countries, and lack of financial support from governments is the most important cause of this situation. It is considered that governments which are spending large amounts on insect control, in particular malaria eradication, should devote an adequate proportion of these funds to supportive research, as an insurance that their campaigns will not result in ultimate failure. Support should also come from national and international agencies and private industry. Such assistance is required also to finance training programmes for technical personnel and the procurement of equipment and of essential research tools, such as radioactively labelled insecticides.

The main lines of research indicated by the WHO conference are in the fields of genetics, physiology, biochemistry, ecology and development of new insecticides.

The experts at the Conference have defined the role they expect WHO to play in stimulating and coordinating research on an international scale, and urge that information concerning insect resistance should be circulated rapidly to all interested workers.

#### PHENYLKETONURIA.

In 1934 A. Fölling described an hereditary metabolic abnormality characterized by excretion in the urine of phenylpyruvic acid and mental deficiency. The metabolic abnormality has been shown to be lack of ability of the body to oxidize phenylalanine to tyrosine. This condition is a perfect example of what Garrod called "inborn errors of metabolism". The condition is easily recognized by the production of a green colour when ferric chloride is added to the urine of a mentally deficient child.

Several reviews of work done on the disease have appeared during the last few years, and a particularly well documented review with much original observation has recently been published by W. E. Knox and D. Y. Y. Hsia.<sup>1</sup> They state that it has been clearly demonstrated that phenylketonuria is a recessive condition transmitted by a single autosomal gene and that it conforms to the Mendelian laws of inheritance. The condition occurs only in persons who receive two of the abnormal genes, one from each parent—that is, the patient is homozygous for this abnormality. A heterozygous person will not show any of the symptoms of the condition, but can be recognized by a chemical test—abnormal excretion of phenylalanine in the urine when a large dose of phenylalanine is administered (D. Y. Hsia, K. Driscoll, W. Troll and W. E. Knox<sup>2</sup>). The calculated frequency of heterozygotes in the population is somewhat more than one per hundred people, or about the same frequency as mental illness in general.

In the affected subject, the enzyme which converts phenylalanine to tyrosine is either absent or almost completely functionless because of some abnormality in the constitution of the protein of the enzyme. About 10% of

the normal conversion of phenylalanine to tyrosine takes place. Several abnormal substances appear in the urine of subjects of the disease in addition to phenylpyruvic acid. The major substances excreted are phenylalanine, phenylpyruvic acid, phenyl-lactate, phenyl-acetate and phenyl-acetylglutamine. In the body fluids there is a high concentration of phenylalanine. A number of other substances are excreted in smaller amounts. These are the same kinds of derivatives of three other amino acids, o-tyrosine, tyrosine and tryptophane.

How these substances arise is one of the unsolved problems, but some come from phenylalanine, as has been shown by C<sup>14</sup> labelling. I. J. Bickis, J. P. Kennedy and J. H. Quastel<sup>3</sup> have shown that phenylalanine in large amounts such as occur in patients with phenylketonuria inhibits tyrosine metabolism in the liver. It seems, to the authors, to be possible that there is transamination between L-tyrosine and abnormal quantities of phenylpyruvic acid in the tissues. In a condition recently described, Hartnup's disease, J. B. Jepson<sup>4</sup> has shown that similar indol derivatives appear in the urine together with other amino acids. Clinically this condition is characterized by pellagra-like skin rashes accompanied by cerebellar ataxia and mental deterioration. Jepson suggests that there is a diversion of tryptophane away from its conversion to nicotinamide.

The utilization of phenylalanine for the production of proteins appears to go normally in phenylketonuria. One of the apparent effects of the inability to convert phenylalanine to tyrosine is a reduction of pigmentation in the body, for the patients are almost always of the fair-haired, fair-skinned type, and the new hair is darker if large doses of tyrosine are administered. Abnormalities of the central nervous system are features of the condition. The patients are of low-grade intelligence except perhaps in the first few months of life, the majority being idiots. How the changes are brought about in the central nervous system cannot yet be determined, for we do not know enough about the metabolism of the brain. However, apparently the changes here and in other tissues are not shown at birth, but develop during the months following birth. Many forms of treatment have been tried, but until recently without success. The current treatment is to produce a partial phenylalanine deficiency to eliminate the accumulation of phenylalanine and its derivatives. Patients are fed with a diet complete except for phenylalanine, and the results have been good up to a point. The latest report, by F. A. Horner *et alii*,<sup>5</sup> deals with six patients: two treated in their fifth year of life showed sustained increments in their intellectual functioning; of two treated in their third year of life, one showed marked improvement, the other none; two infants treated respectively for twenty-one and seven months showed a healthy developmental pattern.

#### ACUTE POLIOMYELITIS, 1950-1955.

Cases of acute poliomyelitis increased in most countries of the world during the period 1950-1955, but this increase was very uneven, and the number of deaths caused by this disease, although greater than previously, did not follow the same upward trend, according to a recent statistical report of the World Health Organization. Nearly everywhere in Europe and America, 1952 was a record year for poliomyelitis, and during the whole five-year period the disease killed relatively more men than women.

In Europe (excluding the eastern countries) there were important outbreaks, and although fewer cases of poliomyelitis occurred than in the United States (with only half the population of the 23 European countries concerned), mortality was considerably higher.

<sup>1</sup> *Am. J. Med.*, 1957, 22: 687 (May).

<sup>2</sup> *Nature*, 1956, 178: 1239 (December 1).

<sup>3</sup> *Nature*, 1957, 179: 1124 (June 1).

<sup>4</sup> *Biochem. J.*, 1956, 64: 14P (September).

<sup>5</sup> *Am. J. Dis. Child.*, 1957, 93: 615 (June).

The following European countries were most severely hit: in 1950 Norway and Sweden (with mortality rates per 100,000 inhabitants of 303 and 224), in 1951 Norway again (mortality rate 628) and Switzerland (mortality rate 183), in 1952 Denmark (with a record mortality rate of 607), in 1953 again Norway (mortality rate 324), in 1954 Switzerland (mortality rate 227). The lowest mortality rates were recorded in 1950 in Belgium (28 per 100,000), in 1951 in Denmark (two), in 1952 in Scotland (23), and in 1953 and 1954 in the Netherlands (eight and three). Figures for 1955 are incomplete; they indicate a decrease in some countries and a slight increase in others.

In America, serious outbreaks also occurred during the period under review, particularly in Canada in 1952 (4755 cases, 311 deaths, with a death rate of 6.5 per 100 cases) and in 1953, which was a record year for that country (8888 cases, 481 deaths, a death rate of 5.4 per 100 cases). In the United States, 1952 was the worst year, with 57,879 cases and 3145 deaths (a death rate of 5.4 per 100 cases), double that of the previous year; case notifications reached the highest level ever observed in that country since they have been made compulsory. Large outbreaks with many cases, but happily a smaller proportion of deaths, occurred in 1950 in Chile and Mexico, in 1953 in Argentina, Brazil and Mexico, and in 1955 in Mexico, Peru, Porto Rico and Uruguay.

In our own region (grouped in Oceania by WHO) Australia, New Zealand and Hawaii experienced a great increase in morbidity and mortality from poliomyelitis in 1951. The figures for the individual years are as follows: 1950, 2308 cases, 115 deaths (5.0%); 1951, 4779 cases, 348 deaths (7.3%); 1952, 2789 cases, 180 deaths (6.5%); 1953, 2135 cases, 143 deaths (6.7%); 1954, 2165 cases, 81 deaths (3.7%); 1955, 1995 cases, 64 deaths (3.2%).

In the 61 countries and territories from which WHO obtained statistical data, the total number of cases and deaths (shown in parentheses) were as follows: 1950, 69,870 (5822); 1951, 63,199 (5039); 1952, 105,092 (7301); 1953, 85,719 (5611); 1954, 72,549 (4272); 1955, 63,253 (2709). The figures for 1955 are incomplete.

The WHO report stresses the fact that in poliomyelitis, as in other diseases, cases reported to the health authorities usually represent only a fraction of the cases actually existing. Death statistics are considered to be more complete and consequently more exactly comparable as between countries.

#### AN AUSTRALIAN RADIOLOGICAL JOURNAL.

We are interested to receive the first number of the first Australian journal devoted to medical radiology. The *Proceedings of the College of Radiologists of Australasia* is a handsome production of 76 crown quarto pages printed on art paper with three inset plates printed on heavy art paper. The honorary editor is Dr. William Pook, who has had the assistance of Dr. James Bell, and he works under the direction of an editorial committee consisting of all the members of the executive committee of the College. There are four honorary associate editors. The journal has been printed in Lismore, New South Wales, by Northern Star Limited.

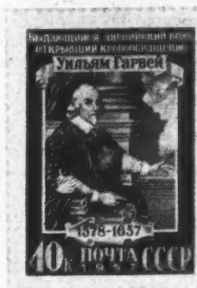
In a foreword the President of the College, Dr. E. W. Casey, remarks that it is more than a coincidence that the decision to publish the *Proceedings* should have been made in the same year that a chair of radiology has been approved at the University of Melbourne and a school of radiology has been established in Sydney. All these activities indicate the increasing interest of radiologists in their speciality and the rapid growth towards maturity of the young College. The President is confident that this interest "will be maintained and strengthened by the men and women who are now being recruited into the College and will continue to be recruited as the practice of radiology becomes more and more attractive".

The text of the *Proceedings* is divided into four sections, radiodiagnosis, radiotherapy, radiophysics and general, the last comprising editorial articles and college notices. Amongst the original articles of interest to the general reader is a review of British, European and American diagnostic radiology by Dr. Gwen Pinner, compiled during her tenure overseas of the Thomas Baker Memorial Fellowship, and a paper on radiation hazards by Dr. D. J. Stevens. The advertising matter includes an amusing skiagram of a handclasp inserted by Watson Victor Limited to symbolize their greetings to the new journal.

We congratulate the College of Radiologists of Australia upon its new venture, so auspiciously begun, and wish the *Proceedings* a useful and successful career.

#### THE HARVEY TERCENTENARY: A RUSSIAN STAMP.

The tercentenary celebrations of the death of William Harvey, which occurred on June 3, 1657, have aroused interest throughout the world, and not least in the Soviet Union, where Harvey has been much admired. Through the kindness and courtesy of Mr. A. Dickson Wright, Surgeon to St. Mary's Hospital and Prince of Wales Hos-



pital, London, who is at present visiting Australia, we are able to reproduce here a Russian postage stamp, issued on June 14, 1957, to commemorate the Harvey Tercentenary. The value of the stamp is 40 kopeks. The portrait of Harvey on the stamp is copied from the well-known portrait which hangs in the Royal College of Physicians of London. Harvey's name in its Russian form appears above the portrait, and above that again are two lines which read in translation: "Distinguished English doctor who discovered the circulation of the blood."

#### DIVERTICULA OF THE COLON AND MASSIVE MELENA.

The importance of diverticula of the colon as the source of bleeding in a patient with severe rectal hæmorrhage is rightly emphasized by L. Keith and J. Rini.<sup>1</sup> They consider that diverticulosis may prove to be second only to peptic ulcer as a cause of massive melæna without hæmatemesis. In the series of 317 cases in which the diagnosis of diverticulosis or diverticulitis was made, they found that severe bleeding occurred in 6% and some degree of bleeding in 19%. They state that this finding should furnish added impetus to the acceptance of elective resection in patients with complications of diverticulosis. However, the high mortality reported amongst the patients who underwent emergency resection and the survival of all conservatively managed patients in this series should raise serious doubt concerning the advisability of urgent surgical intervention in all but exceptional cases.

<sup>1</sup> Arch. Surg., 1957, 74: 571 (April).



## Abstracts from Medical Literature.

### PHYSICAL MEDICINE AND REHABILITATION.

#### Respiratory Rehabilitation in Poliomyelitis.

L. LEWIS, G. A. HIRSCHBERG AND J. P. ADAMSON (*Arch. Phys. Med.*, April, 1957) state that the pathology of respiratory paralysis due to poliomyelitis and the resulting physiological manifestations are complex, requiring careful clinical evaluation in respect to rehabilitation potential. Early-phase care, with special reference to adequacy of airway and pulmonary ventilation for the prevention of even transient hypoxia, has a strong influence on prognosis, influencing both rate of progress and extent of rehabilitation. Gradual diminution of respiratory assistance through the use of mechanical devices other than the body (tank type) respirator permits integration of a total rehabilitation programme. The general exercise programme and the respiratory programme must be so inter-related as to avoid fatigue and yet permit maximal activity. A variety of devices and the non-mechanical method of glossopharyngeal breathing aid in the rehabilitation process. Excessive withdrawal of respiratory assistance leads to major metabolic disorder and defeats the rehabilitation programme. The realistic goal of rehabilitation is the maximum feasible activity within the limits of respiratory function.

#### Physical Fitness Index Studies in Diabetics.

H. T. ZANKEL, E. RAYMER AND E. CHORIAN (*Arch. Phys. Med.*, April, 1957) have studied the effect of supervised exercise on the physical fitness index (PFI) of 19 diabetic patients in hospital. Nine who received exercise showed an increase of 29% in their PFI; 10 who did not receive exercise showed an average decrease of 3.7% in their PFI. The authors conclude that diabetic patients receiving proper diet and insulin therapy can increase their PFI by an organized programme of exercise.

#### A Method of Recording the Progress of Scoliosis.

R. L. MAY (*Arch. Phys. Med.*, April, 1957) discusses the factors influencing the decision to operate in scoliosis, and describes an apparatus for estimating one of them—the rate of progression of the curve. An eight-foot steel upright shaft is mounted on a solid base. On the shaft is a collar, to which the recording device is attached. There is a key in the collar, to stabilize it at different levels. The collar is attached to a circular framework containing 36 adjustable calibrated metal rods pointing inward from the circumference of the circle. The patient is placed in a standing position in the centre of the horizontal circle. The rods are then pushed in to conform to the contour of the thorax, the record being obtained from calibrations on the rods. The position of the patient is stabilized by means of a plumb line hung from a bar over his head. Since

lateral deviation is the most prominent feature of scoliosis, it is impossible to centre the plumb line over the entire spine, so a reference point is chosen, such as the spinous process of the seventh cervical vertebra or the occipital protuberance, and the patient is aligned from this point of reference. In some cases a head halter with light traction is helpful. The position of the feet on the platform is recorded as part of the permanent recordings, by means of a scale on the platform, or by measuring the distance from the heels to the edge of the platform; the lateral deviation is also recorded from a central reference line. The author discusses in detail the way in which the recording is done and the application of the method.

#### The Changed Concept of a Rehabilitation Centre.

H. REDKEY (*Arch. Phys. Med.*, April, 1957) discusses the changed concept of a rehabilitation centre. From the original "one-roof" concept, there was a shift of attention to specialized medical facilities that were improperly called rehabilitation centres. The current concept stresses total rehabilitation evaluation for large numbers of handicapped persons in a comprehensive centre, and the concurrent provision of integrated services there for the severely handicapped. A comprehensive centre must include services in four basic areas: medical, psychological, social and vocational. However, it is the practice not to include every possible service in each of these areas, but only to include those most necessary to give the staff a well-rounded view of the total rehabilitation needs of the patient. Essential to this concept are recognition of and integration with the many medical and vocational services carried on outside the centre. There are and will continue to be many varieties of centres; but the comprehensive centres appear to offer the best hope for leadership of all professions and disciplines engaged in rehabilitation. Teamwork in comprehensive rehabilitation centres needs improvement in practice if it is to make its anticipated great contribution to solving the problems of the severely handicapped.

#### Rehabilitation of the Aphasic Patient.

M. MARKS, M. TAYLOR AND H. A. RUSK (*Arch. Phys. Med.*, April, 1957) present the results of three years' experience in the rehabilitation of aphasic patients at the Institute of Physical Medicine and Rehabilitation, New York University-Bellevue Medical Centre. There were 205 patients, ranging in age from three to eighty years. Only a small percentage had traumatically incurred aphasia, the term aphasia being used to indicate language disturbance due to illness in a previously normal person. It was found that age alone did not preclude favourable results, nor did a relatively long duration of symptoms, although earlier therapy produced better results. Even small improvements, if sustained, may warrant additional training. The impression was gained that patients with relatively rigid personality structures did less well than those whose personality before their illness was less restrictive. The authors point out that the emphasis was on the retraining and rehabilitation of the

"total" patient, and they believe that the results are encouraging enough to warrant the extension of such a complete service to a large number of aphasic patients in the community, despite the handicaps of age, disease and relatively long duration of symptoms. A comprehensive language retraining programme will often prove to be of significant functional value, especially to the patient with a predominantly expressive type of aphasia. Therapeutic nihilism on the part of the physician, the family or the patient himself may well be a disservice to the patient; however, therapeutic goals must be realistic.

#### Prevocational Medical Evaluation in Cerebral Palsy.

SHYH-JONG YUE, M. G. MOED AND R. C. DARLING (*Arch. Phys. Med.*, May, 1957) present the results of prevocational medical evaluation of a group of young cerebral palsied adults. They state that a thorough work-up and integration of all the findings are essential if a reasonable prediction of the vocational prospect is to be made. If the patient rates high in physical and mental phases, his vocational prospect is likely to be good. There are other factors, which cannot be taken into account—e.g., the attitude of the parents, and the family situation and environment. Among the readily classifiable factors, physical performance stands first in importance. Patients with retarded mentality may often be trained in unskilled work, so long as they are physically capable. On the other hand, very intelligent patients are frequently so severely involved physically that they have no practical means of utilizing their capacity. The authors describe the system of medical evaluation which they are at present using in the hope of finding a workable formula. Their medical evaluation was divided into two phases: (i) the physical, which included evaluation of the ability of the patient in ambulation, self-care and manual dexterity; (ii) the mental, which included psychometric studies, and speech, hearing and psychiatric examinations. In each of the two phases the patient is classified in one of five grades. So far the classification used has been found to coincide roughly with the results of the vocational testing.

#### Understanding in Rehabilitation of the Severely Disabled.

S. M. REICHEL (*Arch. Phys. Med.*, May, 1957) states that rehabilitation of a severely disabled patient requires an intensive, cooperative effort by all concerned, particularly the patient, who is the most important single member of the team. Easy communication is necessary for team work, and mutual understanding is a prerequisite to communication. It is therefore essential that the patient be understood by the other team members, so that he may freely communicate his hopes, fears, needs and opinions. Emotional stress, egocentric orientation and depression are natural, although undesirable, parts of the symptom complex of the early phase of severe disability. The severely disabled patient, being hypersensitive, may be said to look at life through magnifying lenses. His many trivial symptoms, fears and complaints are not trivial to him, and it is important



that they be listened to understandingly and investigated immediately so that prompt reassurance can be given. Recognizing the hyperactivity of the severely disabled patient, staff members should not permit themselves to be upset or angered by the violence of the patient's reaction to an apparently insignificant incident. If any changes are necessary in the patient's treatment or accommodation, the physician should carefully prepare him for them. During the entire course of rehabilitation, the staff should never let the patient feel that he is a burden to them. The general atmosphere should be permissive within limits, rather than unduly restrictive. Severely disabled patients respond best in a rehabilitation setting where they may receive treatment geared to their particular needs by a specially trained and orientated staff, among fellow patients who are also severely disabled.

#### Prevocational Evaluation for the Severely Handicapped.

W. M. USDANE (*Arch. Phys. Med.*, May, 1957) states that prevocational evaluation criteria for the severely handicapped should be concerned with standards demanded for employment in competitive jobs. These jobs should be represented by work samples that test individual skill and endurance. Capacity for supervisory roles, ability to get along with fellow workers, work tolerance, attendance initiative and other specific items can be assessed within the prevocational unit in the rehabilitation centre or in the workshop or hospital setting. Norms for the work samples may be established with the help of an advisory committee, both lay and professional. However, the individuality of each severely handicapped person makes it impossible to develop rigid criteria. Instead, judgement and appraisal of work samples may be considered in five classifications: superior, above average, average, below average, inferior. Final decisions should be made through the pooling of all information concerning the individual under consideration from the rehabilitation team.

#### MEDICINE.

##### Traumatic Heart Disease.

O. JERVELL (*Acta med. scandinav., Supplementum CCCIX*), writing one of a symposium of papers dedicated to Carl Müller, draws attention to the existence of cardiac disorder precipitated by trauma to the thorax. He mentions first that penetrating wounds of the heart are often fatal, and that if the patient survives he may later suffer from cardiac failure. He goes on to say that it is non-penetrating trauma that is responsible for most traumatic chronic heart disease. Many of the patients are in the higher age groups. It is possible that they have suffered from "previous, latent organic heart disease". He states that trauma will certainly, in many cases, aggravate an already existing disease or lead to activation of a latent heart condition. He quotes a number of cases in which injury was held responsible for such symptoms as auricular fibrillation, cardiac

pain, dyspnoea etc., in the presence of organic cardiac disease. In other cases, injury, such as pressure from the steering wheel of a motor car involved in an accident, may cause symptoms and objective signs of cardiac damage in young and previously healthy persons. In these latter cases the prognosis is better. The mechanism of cardiac injury is uncertain. It is pointed out that the heart, particularly the right auricle, may be squeezed against the liver. This may be responsible for transient arrhythmia. In other cases it is suggested that coronary arteries may be damaged and become obstructed by thrombus. In other cases, again, bruising of the pericardium and myocardium occurs. After injury to the chest it is not uncommon to find evidence of pericarditis. Finally, the author points out that the evaluation of the aetiological significance of injury in cardiac disease may be difficult. The shorter the latent period after the trauma, the more probable the connexion between trauma and the subsequent symptoms.

##### Moniliasis.

E. T. WRIGHT *et alii* (*J.A.M.A.*, January, 1957) discuss the treatment of moniliasis with "Nystatin". "Nystatin" was originally isolated from *Streptomyces noursei*. It possesses in-vitro activity against saprophytic and pathogenic fungi. It has been used topically and systemically in man for the treatment of moniliasis. In this report patients with skin and mucous membrane moniliasis were treated by local and oral administration. Forty-two patients with oral moniliasis, 17 with vaginal moniliasis, and 63 with paronychia, intertrigo or perlèche, were treated with ointments, solutions, powders, troches or capsules, and with suppositories or jellies for vaginal use. Clinical response was good within three days to a month. The addition of hydrocortisone in some cases shortened the period of illness.

##### Treatment of Sinusitis.

K. L. CRAFT (*J.A.M.A.*, February, 1957) discusses the treatment of sinusitis, which may be infectious or allergic in origin, or both. Nose drops may be helpful in acute sinusitis and harmful in the chronic state. Antibiotics may be helpful, though possibly they are a danger. Chronic sinusitis is frequently allergic, and should be investigated and treated as such. Causative factors include feathers, animal danders, wool, moulds and tobacco smoke. Helpful drugs are ephedrine, calcium, atropine, endocrine glands, thyroid, potassium, antihistamines, ACTH and cortisone. Irrigation of the sinuses and operations to improve the breathing space in the nose may be necessary.

##### Pulmonary Tuberculosis and Diabetes Mellitus.

M. TURNER WARWICK (*Quart. J. Med.*, January, 1957) discusses the relationship of diabetes mellitus and pulmonary tuberculosis, on the basis of a study of 104 patients, of whom 59 were attending a clinic for diseases of the chest and 45 were attending a diabetic clinic. From 1940 to 1954, inclusive, 1851 new patients attended the diabetic clinic. Thirty-four of these were found to be affected with active pulmonary tuberculosis at the time

of their first attendance. Eleven more were found to be affected later in the course of their supervision. To estimate the prevalence of tuberculosis in the general population, the author took the figures obtained by the mass radiography unit of the Central Middlesex Hospital. During 1953 and 1954, a total of 58,867 radiographs were taken of persons over the age of fifteen years. Of these, 296 were found to be suffering from pulmonary tuberculosis. The author uses these figures in preference to those found by the Ministry of Health, because, first, they are from a higher age group and so are more comparable with the diabetic population, and, secondly, the methods of assessment of activity of tuberculosis more closely resembled those used in the author's study. The rate of pulmonary tuberculosis per thousand diabetics was estimated at 18.2, on the basis only of the figure of 34 per 1851 new patients. The rate per thousand in the general population was 4.9. Up to the age of sixty-five years, the incidence of tuberculosis in diabetics was greater in females than in males, except in the decade from forty-five to fifty-four years. In the whole series of diabetic patients with tuberculosis 66% were under the age of forty years. The proportion of young diabetics was greater among patients seen at the chest hospitals than among those seen at the diabetic clinic. Diabetes mellitus was discovered before tuberculosis in 77 of the 104 patients; tuberculosis was discovered first in eight, and tuberculosis and diabetes were discovered together in 19. The severity of diabetes was assessed according to the insulin requirements. The author found no significant difference in the severity of the diabetes in patients with and without tuberculosis. The control of diabetes was assessed on the basis of symptoms, glycosuria, ketosis and hypoglycaemia. The author found that poor control of diabetes was commoner in patients who later became affected with tuberculosis. It was noted also that when control of diabetes was poor, the relapse rate from tuberculosis appeared to be higher. The author mentions that certain radiographic appearances have been described as characteristic of pulmonary tuberculosis in diabetics. The essential feature is a wedge-shaped opacity in which there is evidence of cavitation. In the author's study no specific radiographic features were discovered. In the cases in which the lesions conformed to so-called "diabetic tuberculosis", the clinical features and progress differed from those previously described. Of the 104 patients studied by the author, 21 died. Eleven of these died from tuberculosis. None had been given specific therapy with drugs. The author states that no patient of this series receiving antibacterial drug treatment since 1950 has died from tuberculosis. Four deaths were due to diabetes and six to other factors. Of 46 surviving patients followed for over five years from the diagnosis of tuberculosis, 26 had full working capacity, nine had limited working capacity, and 11 were unable to work, seven being still under active treatment. Seventeen of these 46 patients were regarded as having active disease on radiographic examination.

## British Medical Association.

### VICTORIAN BRANCH: SCIENTIFIC.

A MEETING of the Victorian Branch of the British Medical Association was held on July 3, 1957, at the Medical Society Hall, 426 Albert Street, East Melbourne, Dr. A. E. McCUTCHEON, the President, in the chair.

#### Report of the Consultative Council on Maternal Mortality.

The members of the Consultative Council on Maternal Mortality presented their report on the maternal deaths that had occurred in Victoria for the three years beginning 1953. The members of the Council are as follows: Professor Lance Townsend (chairman), Dr. Barbara Meredith (Director of Maternal, Infant and Pre-School Welfare), Dr. Isabel Ireland, Dr. Kevin Brennan, Dr. Ivon Hayes, Dr. Frank Hayden and Dr. Gavin Johnson.

PROFESSOR LANCE TOWNSEND introduced the members of the Council. He said that it had been constituted in 1952 by the Minister of Health. Long before 1952, medical practitioners in Victoria had been conscious of the need for such a council. In 1926 the Victorian Branch of the British Medical Association had set up a committee to inquire into the conditions of midwifery in Victoria; Dr. Dunbar Hooper was chairman and Dr. Robert Fowler was convener. As a result, Dr. R. Marshall Allan was appointed Director of Obstetric Research. His report resulted, amongst other things, in the establishment of a Chair of Obstetrics in the University of Melbourne. Dr. Marshall Allan was appointed to the chair in 1929, and there was no doubt that at that time he was anxious to set up a Consultative Council in Victoria, for in his files there was a long report from the British Ministry of Health on the investigations of the Committee on Maternal Mortality in Great Britain. In 1939 a Consultative Council had been set up in New South Wales to inquire into maternal deaths that occurred in the metropolitan area of Sydney, and that was the prototype of the one set up later in Victoria. In fact, Victoria had used the New South Wales Council forms and followed its procedure. In 1945 the Victorian Branch of the British Medical Association again passed the following resolution: "That the Chief Health Officer be requested to take steps to establish a Committee to investigate Maternal Deaths in Victoria." Soon afterwards Professor Marshall Allan and a leading Melbourne obstetrician approached Dr. H. N. Featonby (Chief Health Officer at the time) in support of that proposal. Dr. Arthur Wilson, in the first R. H. Fetherston Memorial Lecture, made the suggestion that such a committee should be set up. Dr. Featonby made a strong plea in 1946 to the Minister of Health that a committee should be formed on the lines of the Sydney committee; that was deferred. In 1952 the matter was again opened with the Chief Health Officer, Dr. Kevin Brennan; as a result, the Minister of Health set up a Consultative Council on Maternal Mortality. The scheme differed from that operating in New South Wales in that, first, a free consultative service and flying squad were not instituted, and secondly, all maternal deaths in the State were to be considered.

Professor Townsend went on to say that the Council, when formed, consisted of a chairman (the holder of the Chair of Obstetrics and Gynaecology in the University of Melbourne), the Chief Health Officer, the Director of Maternal and Child Welfare, a senior representative of the honorary obstetrical staff of the Royal Women's Hospital and of the Queen Victoria Hospital, a representative of the Royal College of Obstetricians and Gynaecologists and a representative of the British Medical Association. Since January, 1953, all maternal deaths in Victoria had been notified to the Consultative Council, and in every instance the medical attendant had cooperated in furnishing full details of the medical history. A free post-mortem service had been set up, which allowed for a post-mortem examination in all maternal deaths, with no expense to the relatives. That was an integral part of the Council's work, as the cause of death was often not certain until a post-mortem examination had been performed, and even then there might be some doubt. In 1956 the Council extended its activities into the field of the baby by investigating the stillbirths and neonatal deaths that occurred in the State. For those deliberations three paediatricians had been added to the Council—namely, Dr. Kate Campbell, Dr. Vernon Collins and Dr. John Colebatch. That work was as yet in its formative phase. Professor Townsend said, in conclusion,

that the members of the Council proposed to put before the meeting the results of their first three years' work.

DR. F. J. HAYDEN said that it was his task to indicate briefly the Council's method of classification of the 117 maternal deaths investigated during the three-year period up till December 31, 1956. The Council had included in that investigation all deaths occurring in pregnant women from any cause whatever, from the time of conception up till 28 days after the birth. Thus, unlike some investigations, it included all deaths from abortions and also deaths occurring even as long as four weeks after the confinement. That was necessary, because it could be, for example, that a woman died of pneumonia or lung abscess some considerable time after the birth of the baby, and yet such pneumonia or lung abscess was due to the anaesthetic at the time of the delivery. Any death occurring within the first month, even though not remotely related to childbirth, such as a death by accident in that period, would come under the Council's consideration.

Dr. Hayden then discussed the sources of the Council's statistics. He said that they came first of all from doctors' reports; and the Council wished to thank doctors for their whole-hearted cooperation in sending the Council such detailed reports. The fuller they were, of course, the more helpful they were to the Council in classifying any case. The second source was the Nurses' Board, to which a maternal death had to be reported by the nurse in charge. The third source was the coroner. In many cases of abortion or sudden death, he was the only source of information. In those cases the Council always had the advantage of having a post-mortem report. The fourth source was the Registrar of Births, Deaths and Marriages. Sometimes the Council had picked up a maternal death when the Registrar had noted that the birth of a child was registered within a short time of the death of the mother.

Dr. Hayden then said that there were different methods of classifying maternal deaths under clinical conditions *etc.*, but the Council had classified them into two broad groups: (1) unavoidable (59 cases); (2) avoidable (58 cases). Since sometimes the information available was meagre and very often the actual cause of death was doubtful because of the absence of a post-mortem examination, the Council considered the advisability of having a third category into which those cases could be put. However, it had decided against such a step and put all cases into the foregoing two classes. The Council wished to stress that when the word "avoidable" was used, it did not mean criticism, or imply neglect or carelessness. Nobody knew more than the members of the Council how difficult it was to be always right in judgement and diagnosis. In classifying a case as avoidable or unavoidable, the Council took into consideration, first of all, reasonable skill and knowledge. A man in general practice was not expected to possess any special skill and knowledge that might be expected of a specialist. What was expected of him was that his care and treatment should be in accord with general university teaching of the day. Secondly, the Council took into account the reasonable use of facilities by the doctor and the reasonable presence of, or unreasonable absence of, such facilities. Thus blood might not be reasonably available in a very small, remote country town; yet a death from haemorrhage in a big centre because blood was not available would be regarded as avoidable death, whereas in the former case it would be classified as unavoidable, provided that the doctor made use of the existing facilities. The avoidable deaths were classified in five categories. The first was error of judgement in management on part of the medical practitioner or hospital, and omission or inadequacy of pre-natal care. An example would be if the doctor had failed to measure the blood pressure or test the urine in the ante-natal care of a patient who subsequently died of eclampsia. The second category was failure of the patient to attend for pre-natal care or to follow advice given. Unfortunately that was not uncommon, especially in cases of incipient toxæmia. The third category covered incorrect use of anaesthetic equipment. The fourth category was shortage of hospital beds. That again was a factor in toxæmic deaths, because of the difficulty of having patients admitted to hospital for treatment of toxæmia. The fifth category comprised combinations of any of the others. Originally, after classification of a death as avoidable or unavoidable, the Council had written a letter to the doctor informing him of its opinion. In one or two cases, however, in cases classified as avoidable, the doctor took exception to such a letter, and for that reason the Council now sent the doctor a letter thanking him for his cooperation; but did not define the death to him as being avoidable or unavoidable.



Dr. W. IVON HAYES discussed the avoidable deaths. He said that there were 58 deaths that the Council considered could have been prevented or avoided, and since the majority fell into groups according to the cause of death, they could be classified in the following way: illegal abortion 13, pre-eclampsia 10, eclampsia 13, haemorrhage 5, rupture of the uterus 4, natural abortion 2, anaesthetic deaths 2, miscellaneous 9. In four of the thirteen cases in which death followed criminal abortion, death was sudden, the result of either air embolism or shock; nine women died from septicaemia. With the exception of those self-attempted abortions that caused sudden death, it was not known how or by whom the abortion had been procured. Deaths from criminal abortion were obviously preventable.

Dr. Hayes then said that of the ten deaths from pre-eclampsia toxæmia, nine were directly attributable to the toxæmia, while one—that of the only *primipara*—followed a pulmonary embolus eight days after Caesarean section, performed when artificial rupture of the membranes had failed to induce labour. All ten deaths were considered avoidable; in four cases, adequate ante-natal care was lacking; in two, inadequate ante-natal care was combined with laxity on the part of the hospital staff; and in the remaining four, neglect by the patient to attend her doctor regularly and obey his instructions was to blame. Dr. Hayes then quoted three medical histories to serve as examples.

The first was that of a *multipara*, aged 42 years, pregnant for the fourth time; she weighed 14 stone 7 pounds when she was four months pregnant. Three days before term her weight was 15 stone 7 pounds, the blood pressure was 150/90 millimetres of mercury, and albuminuria was present. She was treated at home for ten days, and then admitted to hospital for medicinal induction of labour, which was unsuccessful. Two days later another medicinal induction failed. She was then sent home; her blood pressure was 150/90 millimetres of mercury, but no albuminuria was present. After two days at home, when she was fifteen days past her due date of confinement, she was again returned to hospital, and on that occasion she responded to medicinal induction and came into labour. Labour lasted five hours, and a child weighing nine pounds was born. It was then noticed that the mother's pulse rate was high; she was pale, and her lips were blue and cyanosed. Although she had been given ergometrine intravenously, she lost about twenty ounces of blood in the next hour. Death from toxæmia of pregnancy and myocarditis took place two hours after delivery. The Council was of the opinion that this death might not have occurred if the woman, whose initial overweight was of grave significance, had been admitted to hospital at the first sign of toxæmia, and if labour had been induced by rupture of the membranes. The use and repetition of the relatively inefficient medicinal stimulation was a mistake that caused dangerous and unnecessary delay.

The second case was that of a woman, aged 30 years, pregnant for the second time, who had gained 30 pounds during pregnancy, though the urine remained clear and the blood pressure unaltered at 130/80 millimetres of mercury. Eight days before her confinement the blood pressure was 130/90 millimetres of mercury. She was admitted to hospital in labour, and a living child weighing seven pounds was delivered five hours later; but no examination of the blood pressure or urine was made in hospital. Shortly after, she complained of headache, stiffness of the neck and inability to move her left leg, and four hours after delivery she became comatose. It was then found that the urine contained "three-quarters" albumin, the blood pressure was 180/100 millimetres of mercury, and the pupils were pinpoint. Still comatose, she was transferred to a public hospital, and on her arrival the left knee jerk was absent, the blood pressure was 190/120 millimetres of mercury, the albuminuria had increased to "five-sixths", and lumbar puncture produced blood-stained cerebro-spinal fluid. She died from extensive cerebral haemorrhage eleven hours after the birth of her child. The Council considered that that death might have been avoided if the weight gain during pregnancy had been more strictly controlled. In addition, failure by the hospital staff to measure the blood pressure and examine the urine had prevented the taking of measures to institute treatment for the toxæmia.

The third case was that of a *multipara*, aged 30 years, 20 weeks pregnant, whose two previous labours had been induced for pre-eclampsia and hypertension; she was admitted to a general hospital for treatment of hypertension. Her blood pressure ranged between 160/100 and 190/120 millimetres of mercury, and after 25 days, during which treatment was found to be ineffectual, she was discharged

and told to report to an obstetric public hospital, where arrangements had been made for her reception. She arrived, two weeks later, with albuminuria ("one-half") and a blood pressure of 210/140 millimetres of mercury. Since four days' treatment did not reduce the blood pressure—she now also had blurring of vision and some generalized oedema—it was decided to perform Caesarean section. The patient's blood pressure and general condition improved greatly during the following 24 hours, but soon after that she was found dead. A post-mortem examination revealed interstitial myocarditis, pneumonitis and chronic pyelonephritis. The Council formed the opinion that that death might not have occurred had the patient been under continuous medical care; it was unfortunate that the patient did not heed the instruction given to her.

Dr. Hayes went on to say that twelve women, of whom six were *primiparae*, had died from eclampsia; in addition, another *primipara* had died from pulmonary embolus, which followed a Caesarean section performed because of eclampsia five weeks previously. All those deaths were classified as avoidable, either because of inadequate ante-natal care or because of the patient's negligence and non-cooperation; in one death both factors were involved. The medical histories, apart from showing the expected higher incidence of eclampsia among *primiparae*, demonstrated the same procrastination and delay in treatment that were mainly responsible for the deaths from pre-eclampsia toxæmia. Dr. Hayes quoted two case histories in illustration of that point.

A *primipara*, aged 31 years, had swelling of the feet and albuminuria at the thirtieth week, and her weight had increased by six pounds in the previous five weeks. She was not examined again for almost six weeks, but her urine was tested every two or three days and was found free of albumin after the first ten days. Examination of the patient just before the thirty-sixth week showed that there was no oedema and that the urine was clear, but the systolic blood pressure had risen to 134 millimetres of mercury. Three weeks later examination of a specimen of urine revealed albumin, and the patient was advised by telephone "to rest in bed and keep to the diet". Two days went by before the doctor was summoned; he found that her blood pressure was 234/134 millimetres of mercury, the urine contained "two-fifths" albumin, there was swelling of the feet, and labour pains were present. Morphine (one-quarter of a grain) was injected, and the patient was transferred to hospital. Five eclamptic fits occurred before delivery, and difficulty was encountered with the shoulders; this was followed by post-partum haemorrhage and manual removal of the placenta. The patient died one hour after delivery from eclampsia and post-partum haemorrhage. The Council held the opinion that that death might not have occurred if the patient had been examined more frequently and treated more efficiently when signs of toxæmia appeared.

The second case was that of a half-aboriginal woman, aged 41 years, pregnant for the fourteenth time, who was left by her relatives at hospital. Her last three pregnancies had been toxæmic, and the children had been stillborn. On the present occasion she was comatose on admission to hospital and had already had several eclamptic fits; the urine contained much albumin and the blood pressure was high. Standard treatment was begun, but as the fits continued, a classical Caesarean section was performed and a stillborn child was delivered. Shortly after, the patient had another convulsion in which she died. This patient, in spite of previous toxæmia and repeated warnings, had not sought any ante-natal care. The Council considered that that lack of ante-natal attention was the cause of death.

Discussing haemorrhage, Dr. Hayes said that five deaths had followed haemorrhage, post-partum in three cases, ante-partum in one case, and traumatic (vulval haematoma and accidental haemorrhage) in the fifth case. In all cases, unavailability of blood or delay in its administration was a contributory cause of death. The following case was quoted in illustration.

A *primipara*, aged 40 years, married for 14 years, came into labour one week after her due date of confinement. Labour was tedious, and because progress was considered unsatisfactory, she was delivered by Caesarean section 36 hours after labour had begun. Two pints of serum were administered during the operation when the patient "showed signs of collapsing". On her return to the ward, she complained of severe abdominal pain, for which she was given 100 milligrammes of pethidine. She collapsed soon afterwards, and died two hours after the operation. At no time during pregnancy or before operation was the haemoglobin value estimated, and no blood was available for resuscitation. The Council recorded that death as "avoidable", because the haemoglobin value was not estimated, and because the total



lack of blood for transfusion showed very inadequate preparation for a Cesarean section.

Dr. Hayes then said that four deaths were due primarily to rupture of the uterus; but, like those caused by hemorrhage, those deaths might not have occurred had there been more forethought, less delay in transporting the patients to more suitable hospitals, or better resuscitation by blood transfusion, as the following clinical history illustrated.

A woman, aged 28 years, pregnant for the sixth time, who had had a hysterotomy two years before the present pregnancy, threatened to abort in the early months. She had hemorrhage and lower abdominal pain, and the uterus was tender; that tenderness persisted throughout pregnancy. At the thirty-sixth week she suddenly became shocked and complained of severe abdominal pain, and a diagnosis of concealed hemorrhage was made. Arrangements were made for her admission to a base hospital some miles away, but, owing to various delays, she did not arrive for more than three hours. She was then in a state of severe shock, with gasping respirations, absence of pulse and unrecordable blood pressure. A diagnosis of ruptured uterus was made, and before laparotomy, which was undertaken three hours later, she was given three pints of blood. Her general condition was fair after the operation, but she died three hours after its completion. The Council considered that that woman's life might have been saved with earlier admission to hospital, more generous blood transfusion and earlier operation.

Two women had died after natural abortion. One, who contracted staphylococcal septicæmia, was nursed in a public hospital ward, which contained patients with breast abscess, but it was not known that cross-infection occurred. She was treated with the correct antibiotic ("Chloromycetin"), and after her temperature had been normal for three days, she was discharged from hospital. But she returned the next day with a temperature of 105° F., and remained febrile in spite of all treatment till she died five weeks later. The Council thought that it was unwise to nurse post-abortion patients alongside others with open infections, that there had been unnecessary delay before smears were taken and examined, and that the patient should not have been discharged so soon after recovery from such a serious disease. The second woman died from hemorrhage because of delay in obtaining blood for transfusion.

Mechanically faulty anæsthetic apparatus had been responsible for the deaths of two women; a "Trilene" inhaler and a gas and oxygen machine were to blame.

Dr. Hayes then gave brief details of the remaining nine deaths, which were due to various causes. The first group had resulted from negligence of the patient; the circumstances were: (i) Death from shock and hemorrhage following the birth of a full-time child; the unmarried mother was found dead at home—she had received no medical attention at all. (ii) Death from chronic nephritis and anæmia (hemoglobin value 32%) at 28 weeks; no ante-natal care had been sought. (iii) Death from obesity, myocarditis and pulmonary embolus at term; no ante-natal care had been sought. The second group of deaths had resulted from an error of judgement by the doctor; the details were: (i) Death from shock and hemorrhage following operation for ruptured ectopic pregnancy; the patient was first sent home, and then, sixteen hours later, she was referred to hospital. (ii) Death from shock and hemorrhage seven hours after inversion of the uterus; serum was given, but there was no attempt to replace the inverted uterus. (iii) Death from shock and ileus 24 hours after the abdomen had been reopened because of ileus six days after a repeat Cesarean section. (iv) Death from shock after the delivery of twins; adequate ante-natal care and proper supervision after delivery appeared to be lacking. (v) Death from bronchopneumonia, acute nephritis, uræmia and anæmia when the patient was three and a half months pregnant; she was treated at home, and not admitted to hospital till four days before her death. (vi) Death from pulmonary embolus ten days after Cesarean section; the doctor would not give the reason for the operation.

DR. ISABEL IRELAND discussed the unavoidable deaths. She said that they were of interest chiefly on account of the clinical material in the histories. There were 59 deaths in the series, and she had grouped them according to cause. There were 28 in the first group, distributed in the following manner:

#### First group (28):

|                                |   |
|--------------------------------|---|
| Pre-eclamptic toxæmia .. . . . | 1 |
| Eclampsia .. . . .             | 3 |
| Hæmorrhage .. . . .            | 6 |

|                                      |   |
|--------------------------------------|---|
| Rupture of uterus .. . . .           | 3 |
| Septicæmia .. . . .                  | 3 |
| Pulmonary embolism .. . . .          | 2 |
| Probable pulmonary embolism .. . . . | 7 |
| Probable virus infection .. . . .    | 3 |

Dr. Ireland said that it would be observed that most of the conditions named were of essentially obstetric nature, and, as would be seen later, they were less numerous than in the "avoidable" group. In the clinical details of those cases there was evidence that excellent ante-natal supervision or prompt action in emergency was not enough to avert tragedy. Dr. Ireland said that she intended briefly to discuss a few points about the first 16 patients, and then to pay more attention to the last 12, whose deaths were more or less unheralded, and whose final crises were dramatically sudden. Those 12 were grouped under the headings of pulmonary embolism, probable pulmonary embolism and probable virus infection. Finally three histories would be touched upon, to stress difficulties in diagnosis in the absence of necropsy. Those three deaths had been caused by diseases incidental to pregnancy, and were included in the remaining list of causes of death, which could be set out in the following manner:

#### Respiratory disease (5):

|   |   |
|---|---|
| Pneumonia .. . . .                              | 3 |
| Lung abscess .. . . .                           | 1 |
| Status asthmaticus and cardiac failure .. . . . | 1 |

#### Cardiac disease (9):

|   |   |
|---|---|
| Mitral stenosis with cardiac failure, pneumonia and pulmonary oedema .. . . . | 1 |
| Mitral stenosis with interstitial pneumonia .. . . .                          | 1 |
| Mitral stenosis with pulmonary oedema .. . . .                                | 1 |
| Pericardial effusion .. . . .   | 1 |
| Tetralogy of Fallot, cardiac failure .. . . .                                 | 1 |
| Pulmonary hypertension, cardiac failure .. . . .                              | 1 |
| Myocardial failure, Cushing's syndrome .. . . .                               | 1 |
| Cardiac failure .. . . .  | 2 |

#### Central nervous system disease (5):

|   |   |
|---|---|
| Bulbar poliomyelitis .. . . .   | 2 |
| Secondary carcinoma, brain and skull .. . . .   | 1 |
| Probable cerebral tumour .. . . .   | 1 |
| Acute degenerative and inflammatory changes around cerebral vessels and pulmonary infarcts .. . . . | 1 |

#### Epilepsy (2):

|  |   |
|--|---|
| With cerebral hæmorrhage and embolism .. . . . | 1 |
| With interstitial pneumonia .. . . .           | 1 |

#### Miscellaneous

10

The causes classed as "miscellaneous" comprised the following: septicæmia (considered a probable cause of death), acute yellow atrophy and liver failure, miliary tuberculosis, acute nephritis, diabetic coma, cardio-renal disease, dissecting aneurysm, adrenal failure (Addison's disease), probable intravascular hemolysis and acute liver necrosis, and probable myocardial embolus.

Referring first to toxæmia, Dr. Ireland said that it might be questioned why pre-eclampsia and eclampsia were regarded as unavoidable. Those were fulminating cases, not prevented by careful prophylaxis, as an example would show. A *primigravida*, aged 22 years, had one excess weight gain between the thirty-first and thirty-fifth weeks of pregnancy. Her diet was checked and advice was given. At thirty-eight weeks a rise in blood pressure to 145/85 millimetres of mercury was treated by rest in bed. A week later there was no improvement, and the woman was advised to enter hospital. Before reaching there she had an attack of convulsions. On examination of the patient, the clinical signs pointed to eclampsia. Labour began at once and lasted eleven hours, during which time two more fits occurred. Conservative management was employed, and at full dilatation forceps extraction was performed. Thereafter the urinary output remained satisfactory, but bruising appeared at the sites of injection. In spite of constant care, five hours after delivery there was a sharp hæmorrhage *per vaginam*, and five minutes later a large hæmatemesis, after which the patient died.

With regard to hæmorrhage, Dr. Ireland said that certain deaths could not be averted. There were two deaths from accidental hæmorrhage; one woman died on the eleventh day from anuria and pulmonary oedema, the other died from post-partum hæmorrhage. In the hæmorrhage group also were two deaths from post-partum hæmorrhage associated with afibrinogenæmia. The first woman at full term failed to recover clotting power after 13 pints of blood had been

given intravenously. The second died 24 hours after the beginning of haemorrhage from abortion. The uterus was emptied, and "Intradex", saline, 35 pints of blood and 14 grammes of fibrinogen were given. Dr. Ireland said that at the present time fibrinogen was available in larger doses. Another woman had died from post-partum haemorrhage. The doctor, sent for in the early hours, delivered an hysterical woman of an apparently asphyxiated infant after precipitate labour. He had no skilled help, and added to that disadvantage the ambulance he had ordered failed to arrive on time. He gave the woman ergometrine for moderately severe post-partum bleeding (10 to 20 ounces), and rushed the infant to hospital a mile away. The woman arrived in the ambulance soon after, but she had lost blood freely in transit, and bleeding continued in hospital. Oxytocics and anti-shock measures including two pints of blood were given. Consultants arrived, but she was beyond help.

Dr. Ireland then said that the three *multiparae* who died from rupture of the uterus had had uneventful labours until the appearance of shock at the end of the second stage or early in the third stage. Each woman died quickly. In one the left uterine artery had been severed by the tear. Two of the women had had children and several abortions, and the third had had five deliveries.

Of the patients with septicaemia, two women, each at eight weeks of pregnancy, had *Clostridium welchii* infections and the third had staphylococcal septicaemia. The last died on the twelfth day *post partum* after normal delivery at 38 weeks of pregnancy. The puerperium was normal until the sixth day, when her temperature was 102.6° F. and her pulse rate 120 per minute. On the following morning the temperature was 103.6° F. On the next day (the eighth) vomiting and diarrhoea, abdominal distension and a petechial rash were present. Cyanosis, icterus, oliguria and oedema followed. Hyperpyrexia, unconsciousness and delirium preceded death. Investigation revealed staphylococci in cervical smears and *Staphylococcus pyogenes* in blood culture. From the onset of pyrexia, divers antibiotics were tried without avail. Investigation of personnel etc. failed to demonstrate the source of infection.

Dr. Ireland went on to say that pulmonary embolism as a cause of death was proved in two cases only. In the first, a woman, aged 44 years, delivered normally at 41 weeks of pregnancy, developed a superficial thrombosis in the left leg. The temperature chart showed one "spike" on the sixth day. The leg improved with local therapy, and she was discharged from hospital on the tenth day. She was readmitted on the fifteenth day with deep vein thrombosis, and was treated with antibiotics and anticoagulants. In three weeks she appeared to have recovered, and was discharged. Two months and one day after delivery she was brought back, moribund. Necropsy revealed femoral thrombosis, pulmonary embolus and pulmonary infarction in the lower lobes of both lungs. The second woman was a *multipara*, aged 33 years, who at 38 weeks of pregnancy developed superficial thrombosis in the left leg. She was admitted to hospital, was given conservative treatment, with improvement, and was discharged from hospital in five days. Seven days later she reported with pain in the right leg. Thrombosis of the right saphenous vein was diagnosed, and she was readmitted to hospital. After five days she was found in the toilet, apparently having convulsions. She was removed to the labour ward and examined at once by a doctor. She was cyanosed, vomitus oozed from her mouth and there was no sign of life. Resuscitation was commenced. Ten minutes after collapse she had not revived, so a post-mortem Caesarean section was performed. The child lived and showed no signs of cerebral damage later. At necropsy, pulmonary embolus and saphenous vein thrombosis were found.

Dr. Ireland said that in the group of deaths due to probable pulmonary embolism were included cases in which the mode of death was such as to suggest a vascular catastrophe, but in which necropsy was not performed. She gave six examples. (i) A young, apprehensive *primigravida*, aged 21 years, had a precipitate labour without anaesthesia. After the third stage there were signs of mild shock, from which she recovered with treatment. Three hours after delivery she complained of pain in the chest and faintness, and became increasingly distressed, cyanosed and pallid. In spite of treatment she died six hours after delivery. (ii) A *multipara*, aged 30 years, was delivered spontaneously of twins at 36 weeks. There was moderately severe post-partum haemorrhage. On the third day *post partum* her temperature rose to 105° F., and her pulse rate to 120 per minute. The condition subsided with treatment, but mild pyrexia recurred on the twelfth day and persisted till the twenty-first day, when she suddenly complained of pain in

the chest and died in a few minutes. (iii) A *multipara*, aged 29 years, had a normal labour at full term. She "arrived home" on the twelfth day, and shortly afterwards developed pleurisy at the base of the right lung; her condition was improving by the seventeenth day, but she still complained of pain in the chest. Later that day she developed pain in the left thigh and the left ankle swelled. Three days later the doctor was called and found her dying. (iv) An overweight woman, aged 33 years, had had three Caesarean sections, the first for a brow presentation. At full term the fourth Caesarean section was performed without untoward incident. During the puerperium she occasioned no anxiety until the fifth day, when, a few minutes after she had said how well she felt, the sister found her dying. (v) A *primigravida*, aged 29 years, was delivered by low application of forceps. Moderately severe post-partum haemorrhage followed. The temperature chart during the puerperium was normal, except for one pulse rate reading of 90 per minute. She was out of bed on the fifth day. On the sixth she was allowed to walk 20 yards. She "collapsed with stertorous breathing and white colour", and died rapidly. After death it was found that she had had a sore leg, which proved on examination to be a thrombosed saphenous vein. (vi) A *multipara*, aged 30 years, was delivered normally at full term. There was moderate post-partum bleeding. On the seventh day *post partum* she suddenly slumped in the bed, and died in a few minutes.

Referring to the last group, that covering probable virus infection, Dr. Ireland said that it referred to three patients in the puerperium who died suddenly with minimal or no prodromata. Two were found dead in undisturbed beds within twelve hours of delivery, and one died in a few minutes while ambulatory. At necropsy the macroscopic findings were normal, but microscopic examination revealed evidence of interstitial pneumonia and myocarditis. Virus infection as a cause was presumed, but not proven.

To demonstrate still further the difficulty in accurate clinical diagnosis, Dr. Ireland stated the symptoms of three women, and the diagnosis of each of the cases at post-mortem examination, as follows:

#### Symptoms Before Death.

1. Died suddenly at home at 18 weeks of pregnancy.
2. Occasional cardiac irregularity: pain in chest on eighth day *post partum*; sudden death on ninth day.
3. Excessive weight gain and mild hypertension. Given sedatives after normal labour. Well for 14 hours, lapsed into coma and died one and a half hours later.

#### Necropsy Diagnosis.

- Threatened abortion: pneumonia.  
Dissecting aneurysm.  
Acute degenerative and inflammatory changes around and in cerebral blood vessels; multiple recent pulmonary infarcts.

Dr. J. G. JOHNSON said that in discussing the aims and objects of the Consultative Council on Maternal Mortality, he did so as the only general practitioner member of the Council. He hoped to demonstrate that, although the Council was still in its infancy, it had already rendered a useful service to the people of Victoria, and particularly to the doctors who practised obstetrics.

Dr. Johnson went on to say that, having heard the reports that had been presented, some of those present might well ask what the Council had done for the practising doctor. To those who had been so unfortunate as to have had a maternal death, and then to be asked to fill in the forms required by the Council, that question was one of real moment. All doctors hated filling in forms because of the time-wasting factor; but if they were convinced that the filling in of the form accomplished something worth while, then they were willing to cooperate. As the result of information gained from doctors who had cooperated with the Council, every doctor in Victoria had received a circular on "The Early Diagnosis of Toxaemia of Pregnancy". To the younger members of the profession that might seem superfluous advice; but there were many doctors practising obstetrics who had graduated before the importance of regular weighing of pregnant patients was established, and there were many who had learned little, in their undergraduate training, of modern dietetic prevention and control of toxemia. Thus the Council had been able to help doctors to keep up to date in that branch of their work. The Council had recommended to the profession that a post-mortem examination should be conducted on all mothers who died as a result of childbirth, and had been able to make



available the services of Dr. J. Birrell for that purpose. It was reasonable to assume that, when that service was widely used throughout the State, much of the element of doubt that surrounded some maternal deaths would disappear. Further knowledge might well be gained; that would result in the lowering of maternal mortality in Victoria. Doctors had also been advised that all pregnant patients should have their blood group, haemoglobin value and Rh status determined as a routine procedure. Many doctors had not done that, in the past, and had therefore missed early cases of anaemia of pregnancy, which could easily be corrected by administering iron. Knowledge of the blood group enabled the doctor to deal more quickly, and therefore more efficiently, with any case of haemorrhage, and if the patient was Rh-negative, that fact warned him to look for antibodies in the later months. After the advice to doctors, interviews were sought with members of the blood transfusion service, and the possibilities of improving the availability of blood to country districts were discussed. It was hoped that, as the result of those discussions, blood would become more readily available to doctors in remote areas. On one occasion, the question of performing a post-mortem Caesarean section arose. The Council sought legal opinion, and advised the members of the profession accordingly. It thus sought to protect doctors from unwittingly committing a breach of law. After a maternal death that was thought to be due to "Trilene" anaesthesia, an extensive investigation of several types of "Trilene" apparatus was instituted. Some were found to be unreliable and dangerous, in that under certain conditions they delivered too high a percentage of "Trilene" to the patient. Steps were taken to make available in Melbourne types of apparatus that were found to be reliable under a wide variety of conditions.

Dr. Johnson said, in conclusion, that the aim of the Council was simply to reduce the maternal mortality of Victoria to an absolute minimum. To accomplish that, it would continue to seek the friendly cooperation of all doctors engaged in obstetrics. It would collect and correlate facts, then disseminate the knowledge gained thereby to the profession, in an endeavour to help all members to improve their standard of obstetric practice. He finally stressed two important principles of the Council. The first was that all information was treated with the utmost confidence, the name of the doctor concerned being known only to the chairman. The second was that under no circumstances was blame attached to any doctor. The Council members, as doctors, knew how easy it was to be wise after an event, and to say that it might not have happened if such-and-such had been done; but that did not in any way imply blame for the manner in which the patient was treated. Their attitude to the doctors concerned was not one of criticism but one of sympathy.

In reply to a question by Dr. ROBERT SOUTHBY, Professor Townsend said that to obtain a post-mortem examination after a maternal death, the doctor in attendance should telephone him, and he then would make arrangements with the pathologist.

Dr. R. M. ROME asked whether consideration had been given to the establishment of an obstetrical "flying squad", such as operated in New South Wales.

Professor Townsend, in reply, said that the Council had considered the matter, but was undecided about the need, since in Melbourne facilities were available in emergency from consultants and resuscitators, but were not so readily available in the country.

Dr. W. LEMMON said that the question of a "flying squad" had exercised the mind of many of the obstetricians for some time. There were many factors to be considered, and, while a survey by obstetrical specialists had revealed that all could obtain adequate amounts of blood in Melbourne when it was needed, he realized that the same facilities did not exist in the country. An emergency service was a complex organization, necessarily based on a hospital and available for twenty-four hours of a day. He wondered whether it was really needed.

Dr. J. H. W. BIRRELL said that the tables exhibited during the symposium had perhaps been "loaded" by the inclusion of illegal abortions. He pointed out that even pathologists made mistakes, and a post-mortem examination would not always supply all the answers. As one responsible for conducting post-mortem examinations on behalf of the Council, he would like the meeting to know that his help had always been welcomed by the doctor who attended the patient.

Dr. KELVIN CHURCHES spoke of the shortage of beds for maternity patients, and of the difficulty in persuading private hospitals of the need for beds for ante-natal patients—a need which the public hospitals had realized.

Dr. J. C. LAYR (Medical Superintendent of the Royal Women's Hospital) said that the public hospital group required a greater coverage of beds for ante-natal patients, and at his hospital (excluding ancillary beds located elsewhere than at Carlton) 50% were for such patients. In reference to a "flying squad", he asked whether the Consultative Council had found any cases in which life would have been saved if such a squad had been available.

Professor Townsend, in reply, said that he could think of two such cases, both in country hospitals where adequate facilities were unavailable. He concurred with the opinion of other speakers that Melbourne seemed to be adequately covered.

Dr. McCutcheon, from the chair, thanked members of the panel for all the information that they had given the meeting. He compared conditions at the present day with those of forty years earlier, when as a very young practitioner he had become involved in a case of *placenta praevia* in a small country town where he had no anaesthetist, no trained nurse and no blood. He had effected a breech delivery, and although the child was stillborn, the mother survived.

## Out of the Past.

*In this column will be published from time to time extracts, taken from medical journals, newspapers, official and historical records, diaries and so on, dealing with events connected with the early medical history of Australia.*

### THE COAST HOSPITAL.

[From the *Australasian Medical Gazette*, June, 1887.]

THE report on the Coast Hospital Little Bay (N.S.W.) for the Year 1886 just issued shows that the total number of patients admitted during the year was 1273: 120 or 9.38 per cent died and the average daily cost per head was 3s. 2d. Deducting the expense of transport the cost per head was only 2s. 10d. The prolonged average stay in hospital was due to the admission of a large number of cases of chronic illness which had hitherto been chiefly accommodated in the hospital wards of the various benevolent asylums. Most of the deaths (62) during the year were from zymotic diseases and these all of the miasmatic order.

## Correspondence.

### STAPHYLOCOCCAL INFECTIONS ACCOMPANYING INFLUENZA.

SIR: It is almost certain that the appointment of a special committee will result in an announcement which will place the present influenza epidemic and the coexisting *Staphylococcus aureus* pneumonias in the correct perspective; however, in the meantime I feel I should report my experiences in Europe in 1955, when there occurred an influenza epidemic with which was associated a number of *Staph. aureus* pneumonias. Of the nine cases admitted to the American Forces General Hospital at Frankfurt am Main, Germany, eight died in spite of all antibiotics. It was revealed, however, that whilst the organism was resistant to penicillin in ordinary strengths, it was affected by very high concentrations; the ninth case therefore got fantastically large doses intravenously and recovered. It is also well known that this sensitivity varies from day to day. It will undoubtedly be beneficial to both public and Press when they recognize that all future influenza epidemics will almost certainly be accompanied by this penicillin-resistant pneumonia, and that the present situation has no more definite relationship to "Asian 'flu" than to any other geographic disease.

Yours, etc.,

Imperial Service Club,  
Sydney.

August 20, 1957.

R. V. BRETHERTON.



## Post-Graduate Work.

### THE POST-GRADUATE COMMITTEE IN MEDICINE IN THE UNIVERSITY OF SYDNEY.

#### Post-Graduate Conference at Coff's Harbour.

THE Post-Graduate Committee in Medicine in the University of Sydney announces that, in conjunction with the Eastern District Medical Association, a post-graduate conference at Coff's Harbour will be held on Saturday and Sunday, September 14 and 15, 1957. The programme is as follows:

Saturday, September 14: 2 p.m., registration; 2.30 p.m., "Selective Orthopaedic Problems", Dr. A. R. Hamilton; 4 p.m., "Indications for Plastic Surgery in General Practice", Dr. Basil Riley.

Sunday, September 15: 9.30 a.m., "Some Common Fractures in General Practice", Dr. A. R. Hamilton; 11.30 a.m., "The Repair of Soft Tissue Damage Associated with Fractures of the Extremities", Dr. Basil Riley; 2 p.m., Eastern District Medical Association meeting—medico-political talk.

The fee for attendance is £3 3s., and those wishing to attend are requested to notify Dr. H. E. Masters, Honorary Secretary, Eastern District Medical Association, 23 Victoria Street, Taree, as soon as possible. Telephone: Taree 757.

#### Week-End Course in Rheumatic Diseases.

The Post-Graduate Committee in Medicine in the University of Sydney announces that a week-end course in rheumatic diseases, under the supervision of Dr. Ralph Reader, will be held in the Scot Skirving Lecture Theatre, Royal Prince Alfred Hospital, Camperdown, on Saturday and Sunday, October 12 and 13, 1957. The programme is as follows:

Saturday, October 12: 10.15 a.m., "Social and Industrial Aspects of Arthritis", Dr. Selwyn Nelson; 10.45 a.m., "The Differential Diagnosis of Polyarthritis", Dr. Ralph Reader; 11.15 a.m., case presentations ("Rheumatoid Arthritis")—(a) clinical features and diagnosis, Dr. F. Harding Burns,

(b) management, Dr. Naomi Wing; 12.15 p.m., question time; 2 p.m., "Drug Therapy: Corticosteroids", Dr. John Sands, "Butazolidin", Dr. F. Harding Burns, "Benemid", Dr. Ralph Reader, "Gold", Dr. Selwyn Nelson; 3 p.m., "An Appreciation of the Role of Physiotherapy in the Management of Arthritis", Dr. John Sands; 3.50 p.m., "Collagen Disease"—a recording by Dr. J. H. Sheldon, illustrated with his slides; 4.50 p.m., question time.

Sunday, October 13: 9.15 a.m., case presentations: (a) "Gout", Dr. R. Robinson, (b) "Ankylosing Spondylitis", Dr. Brian Haynes; 10.30 a.m., film, "The Management of Streptococcal Infection and its Complications" (a telecast produced by the American Academy of General Practice, a practical and informative introduction to the study of rheumatic fever); 11.35 a.m., "The Diagnosis and Management of Rheumatic Fever", Professor Lorimer Dods and Dr. Bryan Dowd; 12.10 p.m., question time.

The fee for attendance is £3 3s., and those wishing to attend are requested to make written application, enclosing remittance, to the Course Secretary, Post-Graduate Committee in Medicine, 131 Macquarie Street, Sydney. Telephones: BU 4497-8. Telegraphic address: "Postgrad Sydney."

## The Royal Australasian College of Physicians.

### VICTORIAN STATE COMMITTEE.

THE Victorian State Committee of The Royal Australasian College of Physicians has arranged for Professor A. Baird Hastings, Professor of Biochemistry at Harvard University Medical School, to deliver a lecture entitled "Biochemical Aspects of Carbohydrate Metabolism" in the lecture theatre of the Royal College of Obstetricians and Gynaecologists, LaTrobe Street, Melbourne, on Tuesday, September 17, 1957, at 5.15 p.m. All members of the British Medical Association are invited to be present.

### DISEASES NOTIFIED IN EACH STATE AND TERRITORY OF AUSTRALIA FOR THE WEEK ENDED AUGUST 10, 1957.<sup>1</sup>

| Disease.                                   | New South Wales. | Victoria. | Queensland. | South Australia. | Western Australia. | Tasmania. | Northern Territory. | Australian Capital Territory. | Australia. |
|--|------------------|-----------|-------------|------------------|--------------------|-----------|---------------------|-------------------------------|------------|
| Acute Rheumatism .. ..                     | 3(2)             | ..        | 3           | ..               | ..                 | ..        | ..                  | ..                            | 6          |
| Amoebiasis .. ..                           | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Ancylostomiasis .. ..                      | ..               | ..        | 8           | ..               | ..                 | ..        | ..                  | ..                            | 8          |
| Anthrax .. ..                              | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Bilharziasis .. ..                         | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Brucellosis .. ..                          | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Cholera .. ..                              | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Chorea (St. Vitus) .. ..                   | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Dengue .. ..                               | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Diarrhoea (Infantile) .. ..                | ..               | 7(7)      | ..          | ..               | ..                 | ..        | 2                   | ..                            | 9          |
| Diphtheria .. ..                           | ..               | 4(4)      | ..          | ..               | ..                 | ..        | ..                  | ..                            | 4          |
| Dysentery (Bacillary) .. ..                | ..               | ..        | ..          | ..               | 1(1)               | ..        | ..                  | ..                            | 1          |
| Encephalitis .. ..                         | ..               | ..        | ..          | 1(1)             | ..                 | ..        | ..                  | ..                            | 1          |
| Filariasis .. ..                           | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Homologous Serum Jaundice .. ..            | ..               | ..        | ..          | ..               | ..                 | 1         | ..                  | ..                            | 1          |
| Hydatid .. ..                              | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Infective Hepatitis .. ..                  | 21(9)            | 30(3)     | 1(1)        | 5(4)             | 13(4)              | 2         | 2                   | ..                            | 64         |
| Lead Poisoning .. ..                       | ..               | ..        | 1           | ..               | ..                 | ..        | ..                  | ..                            | 1          |
| Leprosy .. ..                              | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Leptospirosis .. ..                        | 1                | ..        | 10          | ..               | ..                 | ..        | ..                  | ..                            | 17         |
| Malaria .. ..                              | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Meningococcal Infection .. ..              | 2(2)             | 1(1)      | 3(2)        | 2(1)             | ..                 | ..        | ..                  | ..                            | 6          |
| Ophthalmia .. ..                           | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Ornithosis .. ..                           | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Paratyphoid .. ..                          | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Plague .. ..                               | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Polymyositis .. ..                         | 2(1)             | ..        | ..          | 1(1)             | ..                 | ..        | ..                  | ..                            | 3          |
| Puerperal Fever .. ..                      | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Rubella .. ..                              | ..               | 32(15)    | ..          | 15(3)            | 9(1)               | ..        | ..                  | ..                            | 59         |
| Salmonella Infection .. ..                 | ..               | ..        | ..          | ..               | 1(1)               | ..        | ..                  | ..                            | 1          |
| Scarlet Fever .. ..                        | 7(5)             | 13(13)    | 6(5)        | 4(1)             | 1(1)               | ..        | ..                  | ..                            | 31         |
| Smallpox .. ..                             | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Tetanus .. ..                              | ..               | ..        | 1           | ..               | 1                  | ..        | ..                  | ..                            | 2          |
| Trachoma .. ..                             | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Trichinosis .. ..                          | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Tuberculosis .. ..                         | 20(9)            | 27(18)    | 16(8)       | 6(4)             | 7(4)               | 2         | 14                  | ..                            | 92         |
| Typhoid Fever .. ..                        | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Typhus (Flea-, Mite- and Tick-borne) .. .. | ..               | ..        | 4           | ..               | ..                 | ..        | ..                  | ..                            | 4          |
| Typhus (Louse-borne) .. ..                 | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |
| Yellow Fever .. ..                         | ..               | ..        | ..          | ..               | ..                 | ..        | ..                  | ..                            | ..         |

<sup>1</sup> Figures in parentheses are those for the metropolitan area.

## Australian Medical Board Proceedings.

### TASMANIA.

THE following have been registered, pursuant to the provisions of the *Medical Act*, 1918, of Tasmania, as duly qualified medical practitioners: Carroll, David Swainston, M.R.C.S., L.R.C.P. (England), 1951, D.R.C.O.G., 1956; Gilford, Eric John, M.B., B.S., 1957 (Univ. Melbourne); Mainland, John Francis, M.B., B.S., 1957 (Univ. Melbourne); Sherwood, Denise Gordon, M.B., Ch.B., 1952 (Univ. Bristol); Sherwood, Peter Henry, M.B., Ch.B., 1952 (Univ. Bristol); Smith, Hadyn Price, M.B., B.S., 1953 (Univ. Melbourne); Roberts, Douglas Ivor, M.B., B.S., 1946 (Univ. London), F.R.C.S., 1954, F.R.C.S.E., 1950; Von Alpen, Hugo Ulrich Herbert, M.B., B.S., 1951 (Univ. Queensland).

## Congresses.

### SEVENTH INTERNATIONAL CANCER CONGRESS.

THE seventh International Cancer Congress will be held at the Royal Festival Hall, London, from July 6 to 12, 1958. Those planning to attend are reminded that enrolment forms must be received at the Congress office, 45 Lincoln's Inn Fields, London, W.C.2, by January 1, 1958, if a late fee is not to be incurred. Registration forms and the preliminary programme may be obtained from the Secretary-General of the Congress at the address given above.

## Notice.

### CLINICAL BIOCHEMISTRY MEETING.

A SECOND MEETING for those interested in clinical biochemistry will be held at the Maitland Lecture Theatre, Sydney Hospital, on Wednesday, September 4, 1957, at 7.15 p.m. The subject for discussion will be "The Estimation of Steroids and Some Aspects of the Clinical Significance of These Tests", and the speakers will be B. Stacey, Ph.D. (Sydney Hospital), and R. I. Cox, Ph.D. (veterinary physician, University of Sydney). Dr. P. Hall (Sydney Hospital) will be chairman.

## Nominations and Elections.

THE undermentioned have been elected as members of the New South Wales Branch of the British Medical Association: Davis, Ross, M.B., B.S., 1957 (Univ. Sydney); Blanche, Paul Douglas, M.B., B.S., 1955 (Univ. Sydney); Campbell, Eric Charles, M.B., B.S., 1955 (Univ. Sydney); Dorman, George Alan, M.B., B.S., 1955 (Univ. Sydney); Edwards, Lawrence Alfred, M.B., B.S., 1955 (Univ. Sydney); Hillier, Doreen Elisabeth, M.B., Ch.B., 1951 (Univ. Bristol); Hillier, Geoffrey John, M.B., Ch.B., 1952 (Univ. Bristol); Morgan, Brian Patrick, M.B., B.S., 1953 (Univ. Sydney); Russell, Damaris Kaye, M.B., B.S., 1956 (Univ. Sydney); Tuza, Francis Louis Charles, M.D., 1943 (Univ. Budapest), registered in accordance with the provisions of Section 17 (2) (b) of the *Medical Practitioners Act*, 1938-1957; Milder, Emil, M.D., 1929 (Univ. Prague), registered in accordance with the provisions of Section 17 (2) (a) of the *Medical Practitioners Act*, 1938-1957.

## Medical Appointments.

The following have been appointed as members of the Anti-Cancer Council of Victoria: Dr. C. H. C. Searby, Dr. J. E. Clarke, Dr. Konrad Hiller, Dr. K. P. Rush, Dr. Balcombe Quick, Dr. B. A. Stoll, Dr. T. E. Lowe, Professor Sir Macfarlane Burnet, Dr. C. A. M. Renou, Dr. R. Fowler, Dr. R. K. Scott.

The following have been appointed members of the Nurses Board of South Australia: Dr. H. McIntyre Birch (chairman), Dr. R. L. T. Grant, Dr. L. R. Mallen.

Dr. R. A. Burston has been appointed Honorary Assistant Physician in Charge of the Diabetic Clinic at the Royal Adelaide Hospital.

Dr. I. M. H. Camens has been appointed Honorary Visiting Medical Officer, Infectious Diseases Section, Northfield Wards, Royal Adelaide Hospital.

Dr. R. Hecker has been appointed Honorary Assistant Visiting Medical Officer, Infectious Diseases Section, Northfield Wards, Royal Adelaide Hospital.

## Deaths.

THE following deaths have been announced:

MELVILLE.—Alexander Hugh Melville, on August 14, 1957, at Melbourne.

POTTS.—Theodore Kenneth Potts, on August 18, 1957, at Bondi, New South Wales.

## Diary for the Month.

SEPT. 3.—New South Wales Branch, B.M.A.: Organization and Science Committee.

SEPT. 4.—Victorian Branch, B.M.A.: Branch Meeting.

SEPT. 4.—Western Australian Branch, B.M.A.: Branch Council.

SEPT. 6.—Queensland Branch, B.M.A.: Council Meeting.

SEPT. 10.—New South Wales Branch, B.M.A.: Executive and Finance Committee.

SEPT. 12.—Queensland Branch, B.M.A.: Bancroft Oration.

SEPT. 13.—Queensland Branch, B.M.A.: Local Association Conference and Fork Dinner.

## Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Medical Secretary, 135 Macquarie Street, Sydney): All contract practice appointments in New South Wales.

Queensland Branch (Honorary Secretary, 88 L'Estrange Terrace, Kelvin Grove, Brisbane, W.1): All applicants for Queensland State Government Insurance Office positions are advised to communicate with the Honorary Secretary.

South Australian Branch (Honorary Secretary, 80 Brougham Place, North Adelaide): All contract practice appointments in South Australia.

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